ELECTRONIC COMPOSITION

ELECTRONIC COMPOSITION

A Guide to the Revolution in Typesetting

by

N. Edward Berg

N. E. Berg, Inc.

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Foreword

Electronics has revolutionized typesetting technology over the last fifteen years. Electronics has given us character generation at incredible speeds — now up to 10,000 characters per second. Through text editing programs, typesetting's electronic fingers now extend far back into the process of preparing copy, creating a new intimacy between typesetter and client. For many kinds of work, electronics has vastly reduced the cost of the typesetting process. . . and more — made possible new methods of handling reusable information economically; methods that have already led to new printed products and new applications for typesetting.

Within the covers of this book, the salient points of two complex technologies meet for the first time in print: electronic data processing and typesetting. It is the first applications manual in a technology only fifteen years old.

The objective of this book is to take the mystery out of this new technology. To this task, Ed Berg has brought an acute sensitivity to the informational needs of anyone contemplating entry into electronic composition as well as those already in the field. The emphasis is on evaluating hardware and software systems and utilizing them to maximum efficiency — that is, allowing the printer to get the most for his dollar.

The major features to look for in input devices, VDTs, central processing units, phototypesetters, and complete systems are all listed and explained in this book. This material can help the printer cut through the technical jargon that has sprung up in the field. In addition, comprehensive lists of commands for input devices, VDTs, and typesetters are provided to help the printer specify precisely what capabilities he needs for the kind of work he expects to handle.

The author has chosen wisely to present justification and hyphenation programming (two critical functions) in the form of flow graphs rather than the more common flow chart format. In this way, the programming information avoids the pitfall of dependency on the architecture of specific systems. These flow graphs can be used by programmers with limited knowledge of typesetting to begin work on typesetting programs and/or can be used to check the efficiency of programs already in operation.

A serious attempt has been made to make this book very comprehensive. Here again the author demonstrates a clear understanding of the operational problems posed by electronic composition through his treatment of the key, yet-often-forgotten, areas of documentation, site preparation, and diagnostic software. He also gives special attention to major applications of electronic composition: wire service copy and telephone directories. The 7,000 word exception dictionary alone, is worth the price of this book to many printers.

The author's overriding concern is with economics: the cost of a system versus its capabilities. Again and again, Ed Berg returns his discussion to the strengths and weaknesses of various types of equipment, offering the informed judgment of a man who has himself been one of the industry's leading designers of equipment.

Last but not least, the author suggests some directions typesetting technology may take in the near future, not only painting a picture of what is now available but also what is still needed.

The industry is fortunate to have this book. Ed Berg has accomplished the near-impossible by giving us a freeze-frame photograph of a technology still in motion. As such, readers may find some of the author's points arguable. We welcome such comment, since we feel this book is an important starting point for the new era the industry is entering in the typesetting field.

G. W. Bassett
Executive Director
Graphic Arts Technical Foundation

Preface

Of all the disciplines in which the digital computer has made major contributions, typesetting is probably the discipline in which the contribution, in terms of savings, can be the greatest. Although the effort to set type by computer has been underway since the early 1960s it has not yet reached the age of maturity. The technical problems encountered in computer typesetting are difficult. Real time text editing systems involving low-cost minicomputers had to reach a level of maturity before real time typesetting could be economically undertaken.

Many exciting developments have already taken place which are but a prelude to what will unfold in the future. Proper computerization of typesetting now offers very significant cost advantages over hot metal. All publishers and printers should acquaint themselves with this revolutionary new technology which will soon become a necessary way of life.

A technology (that of computers) and a technological art (that of typesetting) are being blended together in a way that is particularly challenging to the computer technology since the typesetting art must be maintained. The computer must assist the art — not dictate or attempt to eliminate it.

When two disciplines come together there is always a need for good communications and standardization — standardization not in terms of the art or expression, but in terms of electronic techniques. The development of these standards allows an orderly application of computer technology and will not detract even minutely from the needs of the art and free expression.

The computer technology will not replace creative human expression but will enable that expression to have enlarged horizons, and leave the mundane and repetitious to the computer.

In all interdisciplinary efforts there is an information gap between the disciplines caused by specialized terminology and understanding. This *Guide* attempts, for the first time, to bridge the technology of computers and the technological art of typesetting.

The thrust of the book is to enable the publisher/printer to understand and utilize computer typesetting systems in a manner that will yield a profit.

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Purpose

Electronic Composition, A Guide to the Revolution in Typesetting, is written for printing and publishing management, typographers, printers, students, programmers and equipment manufacturers. It provides a quick and easy overview of the characteristics of the new, exciting electronic text editing and composition systems to aid them in:

1. Understanding the capabilities and limitations of the electronic composition systems.
2. Evaluating the business impact of the systems.
3. Specifying a system to fulfill the requirements of a particular firm.
4. Procuring or buying the proper system and avoiding the many pitfalls.
5. Utilizing a system to the fullest extent possible to obtain the maximum return.
6. Managing a system and its associated staff.
7. Maintaining a system properly to obtain the maximum ongoing efficiency.
8. Upgrading from any electronic system to the next higher level.
9. Realizing how business scope can be expanded by electronic systems.
10. Evaluating performance in relationship to cost-effectiveness.
11. Forming a basis for all-important 'when and what to buy decision'.

Computers and video display terminals are not 'black magic' beyond the comprehension of management. It is very desirable for management to have a basic understanding of electronics and computers. This understanding will allow management to properly manage computers rather than be managed by them. With this *Guide* and a little effort, the 'black magic' will disappear and these electronic systems, which are becoming a way of life, can be understood and will become comfortable to management.

The system cost effectiveness of an electronic system can be determined before the actual purchase. Purchasing the wrong system with its attendant financial loss can be avoided.

Eventually, electronic systems will almost entirely dominate the spectrum of pre-press data preparation. The publisher/printer who finds himself unprepared in the areas of electronic systems may find himself unprepared to meet competition. This situation could be somewhat analogous to the installation of two-way radios in a taxi company. The radios are installed to reduce costs and to give better service. When one company used them, the radios became a necessary part of all taxi companies if they wanted to remain competitive.

The proper electronics system can produce great financial benefits and product enhancement if utilized efficiently.

GENERAL COMMENTS

With the extreme sophistication and complex options now available in electronic composition, evaluation of these systems by the potential buyer is not an easy task. The potential pitfalls are many. Vendors, ranging from very small companies to very large firms, offer everything from stand-alone Video Display Terminals (VDT) to 'real time' systems. Most of the offerings perform better at text editing than at composition; real time text editing is much easier to do than effective real time composition. Text editing assures that content will be up to publication standards. Real time composition must not only preserve this assurance but convey, as well, a good impression of what the content will look like in print.

Since editing is only a part of the typesetter's problem, a system strong on editing but weak on typesetting has limited value. The number of typesetting commands a system can handle is, of course, important. But even more important is a VDT that gives a good approximation of the final appearance of the composed text as it is flashed on screen. No VDT on the market at this writing can give an exact rendering of what the type will look like when set; those that provide a good approximation are still quite expensive.

'Straight through' systems which take unedited material and produce typeset output should also be handled with caution. After the computer has reacted to the material, the result should be returned to VDT screen for text edit and composition edit as well. A better design would have the computer perform text editing and composition in real time, with the VDT screen displaying both results instantaneously as keys are depressed.

Most of today's systems fall into one of four categories:

1. Primarily text editing.
2. Text editing with unviewable composition.
3. Text editing and delayed viewable composition.
4. Text editing and real time viewing of composition.

Of course, most systems can be upgraded to a higher category to increase operational efficiency. This *Guide* will help you determine exactly where your system — present or proposed — fits into this scheme, and the options open to you for improving it.

MANAGEMENT AND TECHNOLOGY

Executives in the printing and publishing industry today cannot achieve their goals of meeting competition and of serving business, community, and society, unless they are alert to the new developments in computer utilization. They must also understand the available concomitant advantages and developments so that they may administer their business and advance their industry more effectively. Admittedly, automation is not always the panacea it is portrayed to be; but properly administered at this phase in the evolution, it can provide great blessings in areas of cost reduction, efficiency, and control.

The individual executive should study the developments in computer automation sufficiently so that he will be able to assess their significance in his particular business. This is a responsibility he should not delegate — particularly to computer technologists who do not understand the requirements of his particular business. He can learn, in general, what the computer evolution means (not in great detail, but sufficiently) so that he can assess recommendations as to when and where computers can be put to use in his business. He should acquaint himself with general aspects — with capabilities and limitations of the electronic systems. He can rely on the experts for the details, provided he is generally aware of what this information should contain.

Administrators with technical training can communicate more effectively with the computer technologist than can the administrator without technical training. This new *Guide* to electronic composition will provide the non-technically trained manager with the tools of understanding and communication so that he can be more effective in his job. For the manager with technical training, this *Guide* will provide invaluable reference information.

Electronic typesetting systems use electrical charges to represent information to be printed, receive it from input devices, compute with it, store it, set the type on a typesetter, provide accounting data, and provide management with information for reports and control.

Electronic systems can revolutionize typesetting, business systems and procedures, and provide a means for integration of decentralized operations. They are marvelous inventions, but they are not electronic brains; they can only do what they are programmed to do. They cannot provide completely automatic administration nor define the purpose of an organization; that will remain a function of human management. Management may abdicate part of its responsibility by not acquainting itself with the electronic systems or by merely using them because everyone else does.

Computers are not human brains and no matter how skillfully they are programmed, they will never have the human judgment and other abilities so necessary in a successful organization.

It has taken computer system engineers longer to learn the intricacies of the printing and publishing business than it took to generate some very capable computers. This learning process is not over yet, but it has been accomplished to a sufficient degree that the total worthwhile impact of electronics on the industry is beginning to be seen.

An advertising and selling feature of the computer and the electronics industry that is totally new to the printing and publishing industry, is that hoped-for accomplishments are touted as if they already exist.

One of the main problems encountered between the publishing industry and the computer people was that the publishing industry never had the tools to fully evaluate where the ‘computer people’ really were in their development cycles, and the ‘computer people’ never fully realized the enormity of the task they were attempting to do for the printing industry. This new *Guide* is intended to provide help to both.

Boards of directors or top managers often like to see how a computer system has worked elsewhere before they try it themselves. This ‘wait and learn from someone else’s experience’ is not a desirable approach because each large system must be tailored to meet individual company requirements. Even stand-alone VDTs and OCRs (Optical Character Recognition) require a great deal of tailoring. Another even more serious defect in waiting for someone else is that the ‘someone else’ may complete his project without anyone (sometimes not even themselves) ever knowing if the system met its desired performance goals. One never knows if the 'someone else' began with comprehensive goals and specifications and whether the goals apply to them. Even newspapers, whose final products are quite similar, have grossly different system requirements; what is ideal for one may be almost worthless for someone else. In the vocabulary of the computer technologist, there is no global solution — that is, one that applies everywhere. Good outside consultants can sometimes serve a very valuable service by establishing meaningful goals for a particular firm, writing the specifications, determining the implementation order, selecting a vendor, training personnel and operators, and doing a host of other requirements.

Obsolescence in electronics is of deep concern to management. A system life cycle of less than five years will probably not happen with all the startling advances that have been made and those that are predicted. Enhancements to any computer system will probably extend life well beyond five years. With the present rate of labor and cost inflation, the cost of any system should be fully returned within three years.

A large-scale computer system has the following major components: input, computer-processor, and output. (See Figure 1.) The organization of components can be

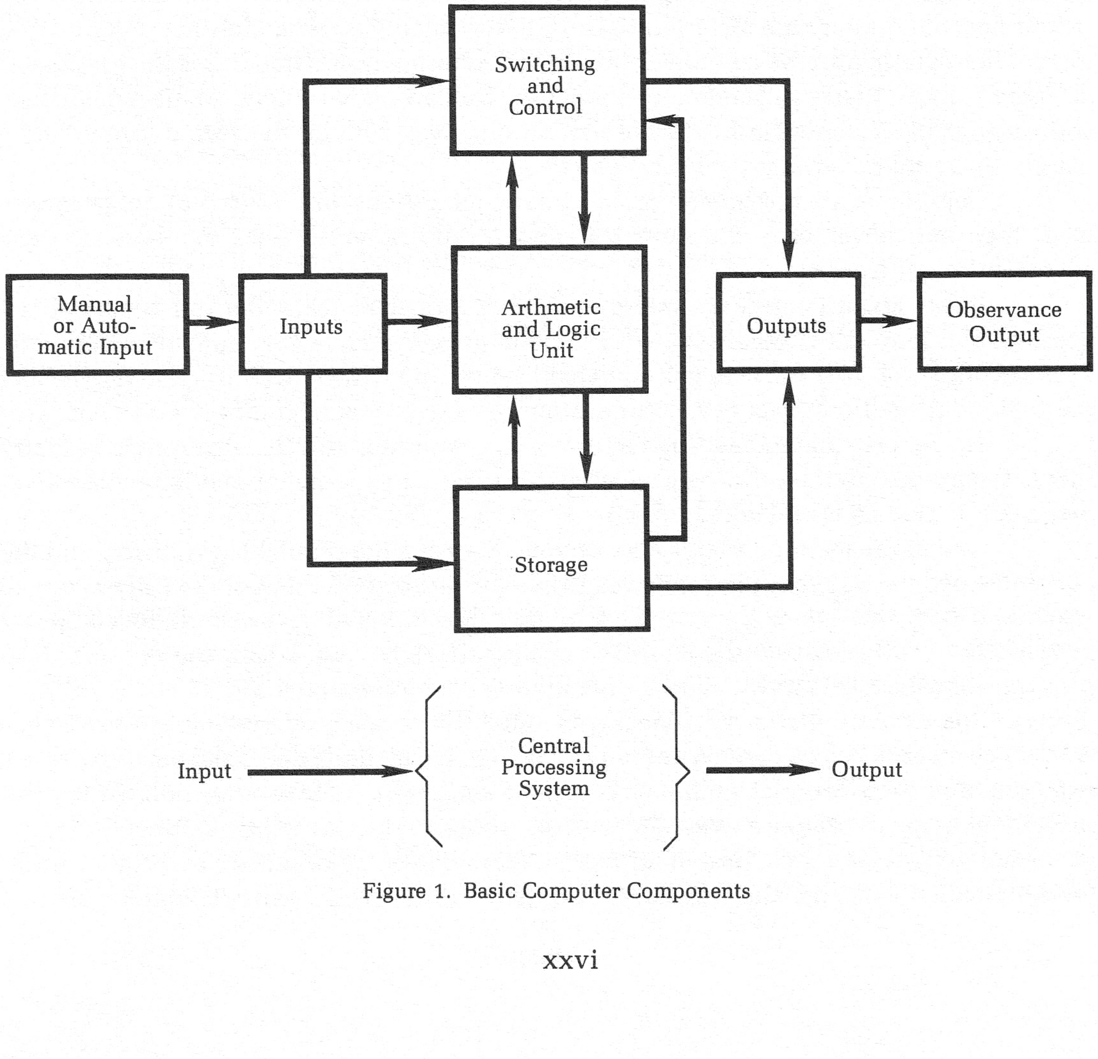

Switching and Control
Manual or Automatic Input
Inputs
Arthmetic and Logic Unit
Outputs
Observance Output
Storage
Input
Central Processing System
Output

Figure 1. Basic Computer Components

compared with the operation of a desk calculator. The keyboard of the calculator is the input, the integrated electronic circuits perform the arithmetic and storage functions of the 'processor', the operational keys provide control, and the indicators are the output.

In computer systems, all these major components are electrically connected so that data can be transferred among them as shown in Figure 1.

Most computer systems have these three major components. These components usually offer different devices to carry out each function, which gives them varying operating characteristics. This Guide is organized in a fashion similar to a computer system. (See figure 2).

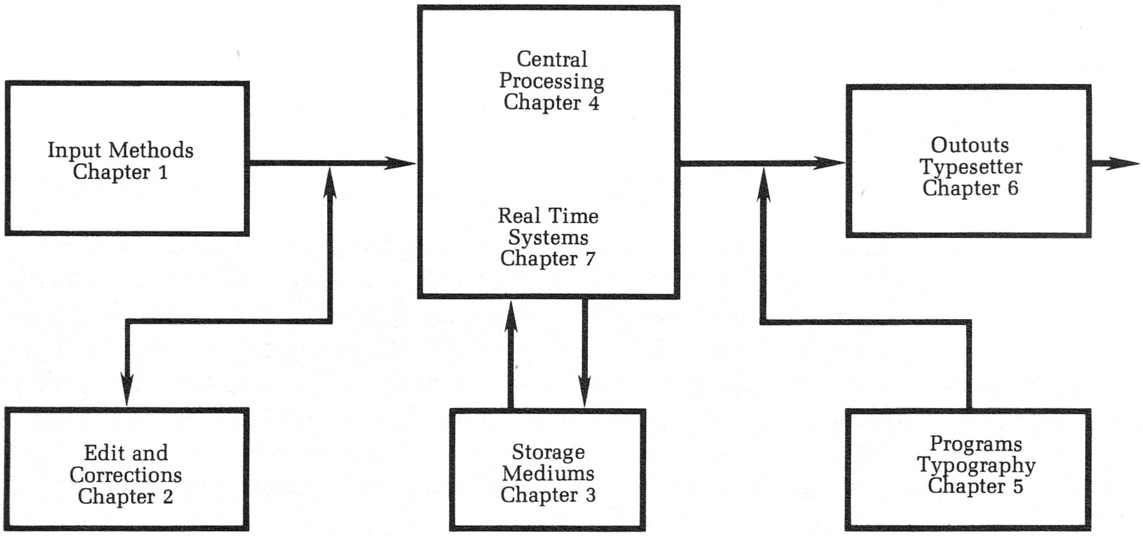

Input Methods
Chapter 1
Central
Processing
Chapter 4
Real Time
Systems
Chapter 7
Outouts
Typesetter
Chapter 6
Edit and
Corrections
Chapter 2
Storage
Mediums
Chapter 3
Programs
Typography
Chapter 5

Figure 2. Computer Organization of the Guide

CHAPTER ONE

INPUT CONSIDERATIONS

A. KEYBOARDS

1. INTRODUCTION

The object of any input process is to create the material or base for copy and to translate the copy into machine-readable form as economically, as quickly, and as accurately as possible. Until somebody translates an idea, comment, statistic, or philosphy into machine-readable form, an automated system can do nothing. This process of copy initiation is labor-intensive and can therefore be expensive. Without an operator somewhere, somehow translating information into machine-readable form, a system, no matter how good, will not produce a thing.

There are basically four input system methods which employ different technical approaches to this process.

1. Hand composition
2. Perforator
3. Optical Character Recognition (OCR) and Optical Bar Recognition (OBR)
4. Visual Display Terminal (VDT)

Hand composition is so rarely used and is so expensive, for anything other than the most trivial volume, that for all practical purposes it can generally be ignored.

In methods two, three, and four, a keyboard is the means used to translate the material into machine-readable form. It is true that some optical character reading machines can read controlled manuscript or handwriting; however, these units lack the flexibility and accuracy needed for the printing and publishing industry and are still very expensive, usually costing more than one-million dollars. The only innovation seen on the horizon which may compete with the last three methods is voice translation. Currently this technique is in its infancy and cannot be considered due to its technical restrictions and enormous cost. For all practical purposes, the only available method of thought translation into machine readable form is through the keyboard.

A keyboard is a bank of keys which, when depressed, will generate a discrete electrical pulse or combination of pulses. Using this device, an operator can 'translate' his thoughts into machine-readable form. When subsequently processed, each pulse or signal represents a character or code. Translation is therefore quite simple. Each block of information is broken down into characters; the depression of an appropriate key will produce a code which will represent and be recognized electrically as a character.

The pulse or signal generated by the keyboard can be interpreted by subsequent devices and stored. A prime example is a keyboard linked to a paper tape punch. When keys on the keyboard are depressed, the signals generated are interpreted by a paper tape punch which records the required code in paper tape. This same principal applies whether the storage medium is magnetic tape cassettes, floppy disks, or the keyboard is on-line to a computer. The keyboarding process should not only generate and store information but it should interpret the information and 'feed back' the information in a more easily-recognized form to the operator. When keys are depressed and the information is punched into paper tape, the data or text is not readily recognizable to the operator. Only a skilled operator can translate the machine language (codes in the paper tape) and understand them. To alleviate this problem, simple keyboard logic and a display of Light Emitting Diodes (LED) which will show representations of the last characters keyed, can be added. This procedure is adopted to enable the operator to conveniently and rapidly review text that has just been keyed. It also allows the operator to return to the proper location in the copy should he leave the keyboard before the reviewing has been completed.

In summary, the keyboard or perforator is seen to have three distinct tasks:

1. Translate the copy into the machine language through the keyboard.
2. Store the text on paper tape or magnetic medium through the output device.
3. Feed back to the operator the required information through the appropriate indicators.

It should be noted that the transfer of information is basically one way; the keyboard 'instructs' the output device and indicators. There is not a great deal of control

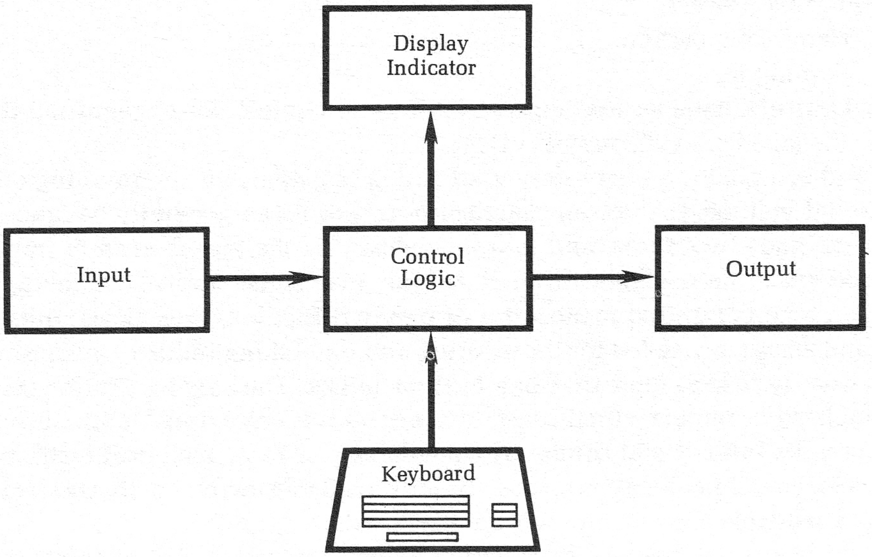


Figure 3. Basic Keyboard Components

information flowing from the indicators or output device to the keyboard. In other words, there is no *communication* between the devices except on a very basic level for operational reasons.

2. KEYBOARD STORAGE MEDIUM

The electrical signals generated by a keyboard have to be stored for subsequent processes, future reference, and data manipulation. The storage medium can be:

1. Paper tape
2. Magnetic tape cassette
3. Floppy disk
4. Magnetic tape

A. PAPER TAPE. Paper tape is the medium which is most familiar to the typesetting industry and is still the most widely used. The technology is relatively simple and the end result, paper tape containing the codes, can be deciphered by the operator. Originally, the raw material, paper, was inexpensive, but with current inflation and raw material shortages, it is becoming an expensive commodity. The tendency is to try to get away from paper tape because of its cost, cumbersome storage (only 10 characters per inch), and difficulty of manipulation when searching for desired information.

B. MAGNETIC TAPE CASSETTES. Magnetic tape cassettes are currently in vogue and offer certain attractions. Cassettes offer better reliability and accuracy than paper tape. An error rate of one bit in 10^7 (equivalent to one error in 10 million characters) is not uncommon. The medium can be used up to 2,000 times with proper handling. The medium is convenient and compact allowing an average of 50,000 printing characters to be stored in each cassette. A further attraction is the high data transfer and search rates that can be achieved compared to paper tape. Standard cassette systems offer reading and writing speeds of 350-750 characters per second. If required, cassette systems can offer up to 6,000 characters per second data transfer and search rates.

Cassette tape decks have been available since 1967. They originally suffered from a reputation of poor reliability in the industry. The reputation was acquired because the early units were adaptations of domestic audio decks; the electronics, magnetic tape, and container were not adequate for industrial use. To a large extent these problems have been remedied. The main criticism of magnetic tape cassettes in the printing and publishing industry has been their inability to quickly and cheaply translate information into human-readable form. This problem is now being resolved with the advent of low-cost dot matrix printers and LED displays. A more difficult problem arises because of the lack of standardization in cassette manufacturing and recording technology. Physical dimensions of the tape and container, methods of recording information, coding structures, and block length all vary. The lack of standardization makes the universal adoption of cassettes extremely difficult and immediately precludes them from many applications.

C. FLOPPY DISKS. The floppy disk is a removable, random-access storage device. The storage space depends on a number of factors but it usually is in excess of 150,000 printing characters. The device was introduced less than five years ago and still retains a fairly high price. However, it will be reduced significantly as time passes, as acceptance grows, and as quantity production increases. The price disadvantage of the floppy disks is outweighed by the speed of search and transmission — up to 44 times faster and with an error rate significantly lower than cassette tapes.

D. MAGNETIC TAPE. Although units do exist whereby it is possible to key and record on computer-compatible magnetic tape, this is normally not relevant to the printing and publishing industry for the following reasons:

1. High Cost
2. Lack of recent technical innovations to meet the requirements of the industry

E. TEMPORARY FEEDBACK STORAGE. With the development of LED displays, better methods of visually presenting or feeding information back to the operator became available. The majority of displays show the last 32 characters keyed. Indicator lights and other visual devices are used to show the status of the unit or a point reached in the text.

3. KEYBOARD PURPOSE

The object of the keyboard is to allow the operator to rapidly and accurately generate electrical signals for the text. This text or data is generated using the character keys. The normal procedure on a 'Qwerty' layout is to have a key for each character and a shift and unshift position for capital and lower-case characters. A typical example is shown in Figure 4.

In addition to text characters, instructions have to be inserted to control the subsequent devices for typeface, leading, point size, etc. The list of instructions varies with

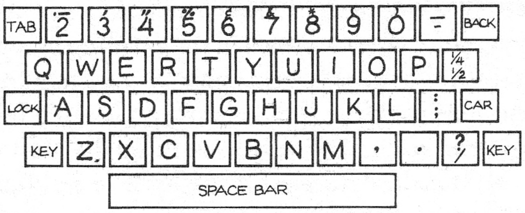

TAB 2 3 4 5 6 7 8 9 0 - BACK
Q W E R T Y U I O P ¼ ½
LOCK A S D F G H J K L : ; CAR
KEY Z X C V B N M , . ? / KEY
SPACE BAR

Figure 4. Typical 'Qwerty' Typewriter Layout

each system, but on the average it can be assumed that more than 200 codes are required for the typesetting of even a simple take of text.

For example, a selection from the following typesetting functions will have to be specified with the basic text: (Detailed explanations of these functions are given in Chapter 5 Section 3.)

Table One. Typesetting Functions

Measure
Type Face
Point Size
Set Size
Leading
Additional Lead
Zero Lead
Forward/Reverse Leading
Immediate Leading
Baseline Jump
Superior by Character
Superior by Block
Inferior by Character
Inferior by Block
Return to Marked Point
One Shot Reverse Leading
One Shot Forward Leading

Quad Left
Quad Right
Quad Center
Quad Middle
Tab Left
Tab Center
Tab Right
Tab Around
Tab at Text
Tab Justify
Tab Leader/Blank
Tab Leader/Character
Tab Proportionally

Ragged Left
Ragged Right
Ragged Center
Ragged Middle

Insert Leaders, Aligned
Insert Leaders, Non-aligned
Insert Character Defined X, Aligned
Insert Character Defined X, Non-aligned
Insert Rule(s), Horizontal
Insert Leader Aligned using a
Insert Leader Non-aligned using a
Insert Left, Aligned
Insert Right, Aligned

Supplementary Line Length
Overset Line Left
Overset Line Right

Letterspace (Automatic)
Maximum Letter Spacing (Automatic)
Letterspace by Character
Kern (Automatic)
Kern by Character
Delete Kern (Automatic)
Delete Letterspace (Automatic)
Specify Maximum Interword Space
Value at which Interword Width begins Letterspacing in a Hyphenated Line

White Space Reduction (Automatic)

Interword Space
Single Time Interword Zero
Set Average Interword Space Value
Set Maximum Interword Space Value
Set Minimum Interword Space Value
Change Variables to Fixed Spaces
Change Fixed Spaces to Variables

Zero Set

Table One Continued

Fixed Space
Relative Unit Space
Em, En, Thin Space
Center Accent (Character)

Delay Command
Runaround Left
Runaround Right
Runaround Left and Right

Vertical Justification

Indent Left
Indent Right
Indent Centered
Multiply Indent
Hanging Indent Left
Hanging Indent Right
Hanging Indent Centered
Indent to Text Left
Indent to Text Right
Automatic Paragraph Indent on Quad Instruction
Indent Length Fit Left
Indent Length Fit Right
Indent Length Fit Left and Right

Hyphenate with Logical Rules
Hyphenate with Rules and Dictionary
Hyphenate with Dictionary
Hyphenation Disabled
Hyphenation Language Selection
Hyphenate after Maximum Space at X
Specify the Number of Letters Preceding or Succeeding a Hyphenation Point
Maximum Hyphenated Lines in Sequence
Disable Hyphenation for Next Word
Specify Minimum Length of Hyphenated Word
Prevent Hyphenated Widows

Discretionary Hyphen
Obligatory Hyphen
Automatically-generated Hyphen

Skew Left
Skew Right
Skew Center
Reverse Skew Left
Reverse Skew Right
Reverse Skew Center

Create Format
Store Format
Use Format
Change Format
Nest Format
Chain Format

Operator Statistics
Operator Identification
Slug Line Film and/or Paper
Tag Line Film and/or Paper
Page Folios (Automatic)
Running Heads (Automatic)
Output Device Verification of Set-Up

Pi Mat (Not in Matrix)
Pi Mat (In Matrix)

Drop Initial
Raised Initial

Ligatures (Automatic)
Ligatures Deleted (Automatic)

No Flash
Normal Flash
Multiple Flash
No Flash until EOL (End of Line)

Horizontal Rule
Vertical Rule

Fractions (Automatic)

Cut Film/Paper

Justify
Justify Inhibit

Define Number of Lines, Mark X
At X Insert Y
X Not to be Z of Line Length
X Not to be a Heading or n
Define Number of Points (Inches, etc.) Mark X
If X Is a Normal Subdivision Insert Multiples of L at n

Small Caps by Size Reduction

Punch/Store Visual

End of Take/Tape
End of Take/Tape with Lead
Halt Tape/Text Display and Continue

Start
Stop

It is often not a simple matter to instruct a typesetter to set even straightforward text. It is possible to increase the code set produced by a simple keyboard by designating one or more of the basic characters as a shift code. Using this method, subsequent devices in the process must recognize the shift code characters and the subsequent characters as function modifiers and not normal characters. Thus it is possible to key $M24# and this will be interpreted as follows:

$ = Shift code-subsequent entries are to be treated as commands or functions and not as normal characters
M = Measure
24 = Twenty-Four Picas
# = Space indicating the End of the Command or Function

This simple example shows the procedure but also indicates:

1. The process involves additional keystrokes.
2. As the typesetting complexity increases, the keyboarding procedure becomes burdensome, prone to inaccuracy, and time-consuming. Keying involves a higher degree of skill and accuracy on the part of the operator.

The keying of instructions is immeasurably more important than keying text simply because one error in the instruction can invalidate the whole of the succeeding text.

An alternative to the shift code is to increase the number of keys on the keyboard. This would assign each function a discrete key or at least require a minimum number of keystrokes and shifting to specify complex typographic functions. Examples of this approach are shown where, in addition to the normal alphanumeric keys, a number of function codes are accessed by individual keys.

It is vital that the keyboard allow the operator to access all the common usage characters and functions with the minimum number of keystrokes and shifting. This is essential to maintain accuracy and speed. It takes up to 30 times as long to correct information as it does to produce it correctly in the first place.

Speed is important because input preparation and production is labor-intensive. Hitherto, the philosophy has been preached for the minimum number of keys on a keyboard; this was reputed to result in faster, less expensive keyboarding. The approach was instigated and exploited successfully by newspapers assisted by the keyboard manufacturers.

Newspapers were first, as a group, to utilize computers and phototypesetters as tools to assist in printing production. In most cases, newspaper requirements, particularly English language newpapers, have minimal requirements for character sets and the newspaper formats are fairly well defined. Display ads in newspapers require a large repertoire of point sizes and typefaces. The requirements for commericial printing, (particularly in mathematical work,) in terms of character sets and typography, are in excess of the newspaper requirements. The use of 'simple' keyboard layouts was and still is being used very effectively by newspapers. This usage suited suppliers because, with few exceptions, they produced simple 'standard' TTS keyboards. However, with the development of photocomposition and commercial systems, the TTS layout was found to be woefully inadequate and a hindrance to efficient keyboarding. After some time, manufacturers responded and the trend toward more comprehensive keyboard layouts with greater flexibility became apparent.

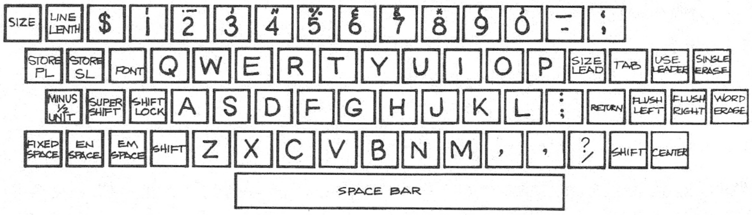

SIZE
LINE LENTH
$ 1 2 3 4 5 6 7 8 9 0 - ;
STORE PL
STORE SL
FONT
Q W E R T Y U I O P
SIZE LEAD
TAB
USE LEADER
SINGLE ERASE
MINUS ½ UNIT
SUPER SHIFT
SHIFT LOCK
A S D F G H J K L :
RETURN
FLUSH LEFT
FLUSH RIGHT
WORD ERASE
FIXED SPACE
EN SPACE
EM SPACE
SHIFT
Z X C V B N M , , ?
SHIFT
CENTER
SPACE BAR

Figure 5. Average 'Qwerty' typesetting layout

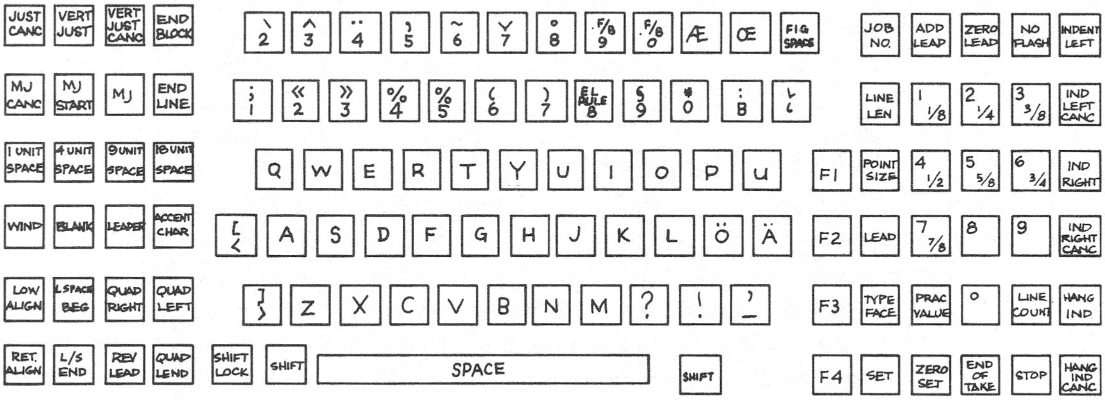

JUST CANC
VERT JUST
VERT JUST CANC
END BLOCK
2 3 4 5 6 7 8 9 0 Æ Œ
FIG SPACE
JOB NO.
ADD LEAD
ZERO LEAD
NO FLASH
INDENT LEFT
MJ CANC
MJ START
MJ
END LINE
1 2 3 4 5 6 7
EL RULE 8
9 0 B
LINE LEN
1 1/8
2 1/4
3 3/8
IND LEFT CANC
1 UNIT SPACE
4 UNIT SPACE
9 UNIT SPACE
18 UNIT SPACE
Q W E R T Y U I O P U
F1
POINT SIZE
4 1/2
5 5/8
6 3/4
IND RIGHT
WIND
BLANK
LEADER
ACCENT CHAR
A S D F G H J K L Ö Ä
F2
LEAD
7 7/8
8
9
IND RIGHT CANC
LOW ALIGN
L SPACE BEG
QUAD RIGHT
QUAD LEFT
Z X C V B N M ? !
F3
TYPE FACE
PRAC VALUE
°
LINE COUNT
HANG IND
RET. ALIGN
L/S END
REV LEAD
QUAD LEND
SHIFT LOCK
SHIFT
SPACE
SHIFT
F4
SET
ZERO SET
END OF TAKE
STOP
HANG IND CANC

Figure 6. Comprehensive 'Qwerty' Typesetting Layout

To a large extent, this trend was made possible by the reduction in the cost of the keyboard logic needed to perform a given function, and to the development of new key switch mechanisms and subassemblies which are used in the manufacturing of a keyboard.

Function	*Decimal value*	*Tape coding*
Stop code	23, 0	Bell + tape feed
Upper pair	23, 1	Bell + thin space
Lower pair	23, 2	Bell + e
Kill line	23, 3	Bell + 3
1-unit space	23, 4	Bell + elevate
Flush right	23, 5	Bell + lower matrix
Leading	23, 6	Bell + a
Add lead	23, 7	Bell + $
Lens 1	23, 16	Bell + return
Lens 2	23, 17	Bell + apostrophe
Lens 3	23, 18	Bell + d
Lens 4	23, 19	Bell + -
Lens 5	23, 30	Bell + r
Lens 6	23, 21	Bell + 4
Lens 7	23, 22	Bell + j
Lens 8	23, 23	Bell + bell
Measure	23, 24	Bell + n

Figure 7. 6-Level Coding List for a Phototypesetter

Function	*Decimal value*	*Tape coding*
Stop code	65	★
Upper pair	66	⬆
Lower pair	67	⬇
Kill line	68	◆
1-unit space	69	☆
Flush right	70	▶
Leading	71	L
Add lead	72	+L
Lens 1	73	S1
Lens 2	74	S2
Lens 3	76	S3
Lens 4	76	S4
Lens 5	77	S5
Lens 5	77	S5
Lens 6	78	S6
Lens 7	79	S7
Lens 8	80	S8
Lens 8	80	S8
Measure	81	M

Figure 8. 8-Level Coding List for a Phototypesetter

4. CODING STRUCTURE

Another restricting factor is the code structure utilized by the system. The commonly-used 6-level TTS code structure has a maximum number of 64 discrete codes. To command a phototypesetter requires in excess of 200 codes. The shift and supershift keyboard principle must be used. Figure 7 shows a code sheet for commanding a typical phototypesetter using 6-level TTS codes. Note that multiple codes are required for most of the functions.

Originally, each command was produced by a defined number of keys and multiple codes, this entailed wasteful keyboarding. Now that programmable keys are available, more than one code can be generated by the depression of one key; this means that an inefficient coding structure does not automatically require inefficient keyboarding.

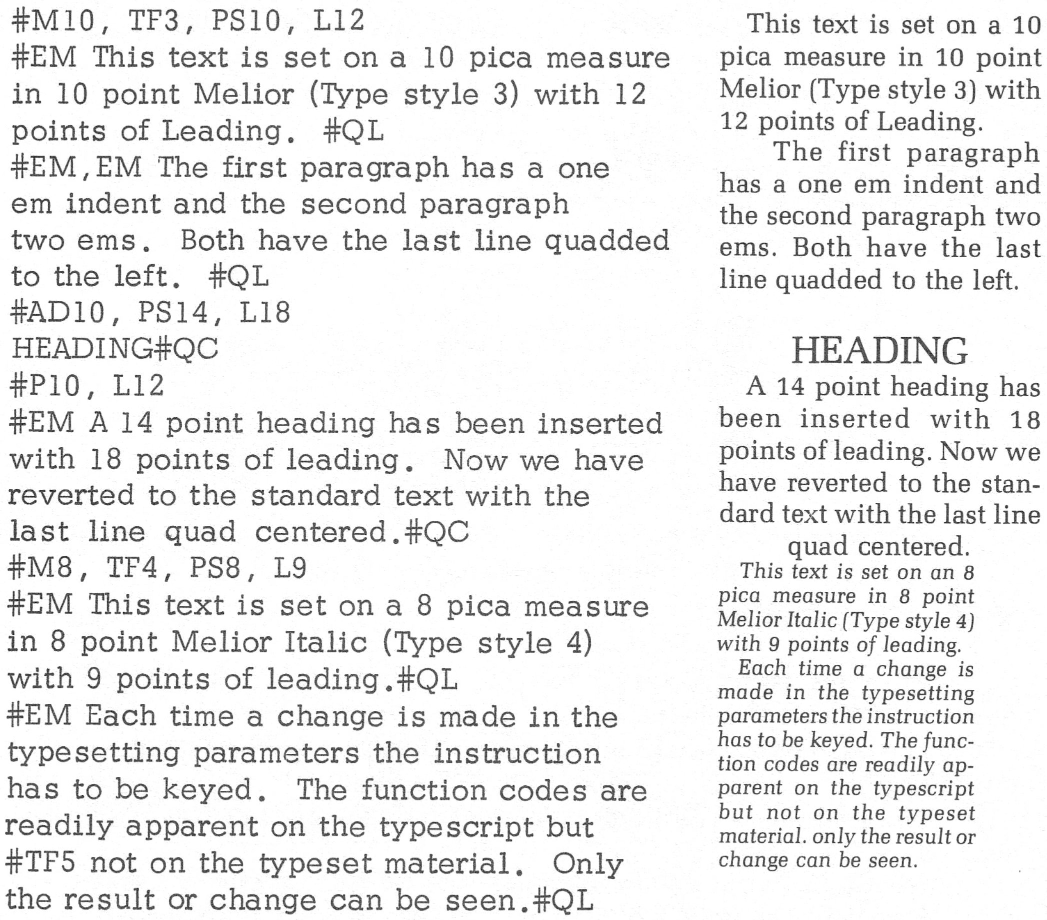
A logical approach to alleviate this multiple-code problem is to use an 8-level coding structure which allows 256 discrete codes.

Single keystroke access will improve output and, more importantly, enable more accurate keyboarding. These two objectives should and can be met by a keyboard that has a competitive unit cost and a reasonable skill requirement on the part of the operator.

The storage medium used to store the keystrokes, paper tape, magnetic cassette or magnetic tape, floppy disk, etc., should be compatible with the subsequent process with respect to physical dimensions, coding structure, and the method of recording data.

5. HARDCOPY

Hardcopy is produced as a natural by-product if a typewriter forms the basis of the keyboard. The hardcopy reflects the operation of the typewriter keys which normally are recorded on the hardcopy. There are other non-print keys such as shift and space on the typewriter. When depressed, a non-print key on the typewriter does not leave a record on



```
#M10, TF3, PS10, L12
#EM This text is set on a 10 pica measure
in 10 point Melior (Type style 3) with 12
points of Leading. #QL
#EM,EM The first paragraph has a one
em indent and the second paragraph
two ems. Both have the last line quadded
to the left. #QL
#AD10, PS14, L18
HEADING#QC
#P10, L12
#EM A 14 point heading has been inserted
with 18 points of leading. Now we have
reverted to the standard text with the
last line quad centered.#QC
#M8, TF4, PS8, L9
#EM This text is set on a 8 pica measure
in 8 point Melior Italic (Type style 4)
with 9 points of leading.#QL
#EM Each time a change is made in the
typesetting parameters the instruction
has to be keyed. The function codes are
readily apparent on the typescript but
#TF5 not on the typeset material. Only
the result or change can be seen.#QL
```

This text is set on a 10 pica measure in 10 point Melior (Type style 3) with 12 points of Leading.

The first paragraph has a one em indent and the second paragraph two ems. Both have the last line quadded to the left.

HEADING

A 14 point heading has been inserted with 18 points of leading. Now we have reverted to the standard text with the last line quad centered.

This text is set on an 8 pica measure in 8 point Melior Italic (Type style 4) with 9 points of leading.

Each time a change is made in the typesetting parameters the instruction has to be keyed. The function codes are readily apparent on the typescript but not on the typeset material. only the result or change can be seen.

Figure 9. Hardcopy and Resultant Typeset Material.

the hardcopy. These non-print keys are often used to specify typographic commands.

In some cases, the logic of the keyboard is such that depression of a 'non-print' key will cause an appropriate 'message' to be returned to the typewriter and a combination of characters to be typed. This records a 'non-print' key depression. An option is available on some keyboards whereby a typewriter or printer can be connected to the keyboard to produce hardcopy of the text keyed.

The limitation of hardcopy is either determined by the ability of the typewriter or printer to produce the range of symbols required or the ability of the logic to control the printer and produce a combination of characters which represent functions for which individual symbols do not exist. An example of a hardcopy printout and the text produced on the phototypesetter can be seen in Figure 9.

6. COUNTING KEYBOARDS

Stand-alone keyboards have further logic added to them to enable counting of character widths. This facility allows the operator to justify and hyphenate the text by using the information derived from the counting logic and his own judgment.

The principal points to consider when evaluating the ability of a counting keyboard are:

1. The accuracy of the counting mechanism.
2. The feedback of information to the operator.

Several methods of 'loading' the widths of the characters into the keyboard are used. Width cards, plugs, etc., are effective electrical circuits which, when plugged into the keyboard, can either:

1. Generate electrical pulses or signals representing the width of each character.
2. Connect circuits in the keyboard which already contain the width information of the characters.

In each case, it should be ascertained whether or not it is possible for any character to have any width within the restrictions set by the typesetter or whether the counting mechanism only approximates widths within its own limitations. For example, will a 7-unit space be accessed when the true character width is 7½ units, simply because 7 is the nearest value stored in the keyboard?

If the counting mechanism only approximates character widths, then the visual feedback to the operator can only be an approximation. Recently, keyboards and input devices have allocated electronic memory space which can store character widths as opposed to separate width cards or plugs. In addition to the line width and character width counting information, the operator needs to know the typeface, point size, and leading information.

The principle of all counting logic is simple, the operator can 'set-up' or instruct the keyboard on the measure required. The precise method of set-up depends on the

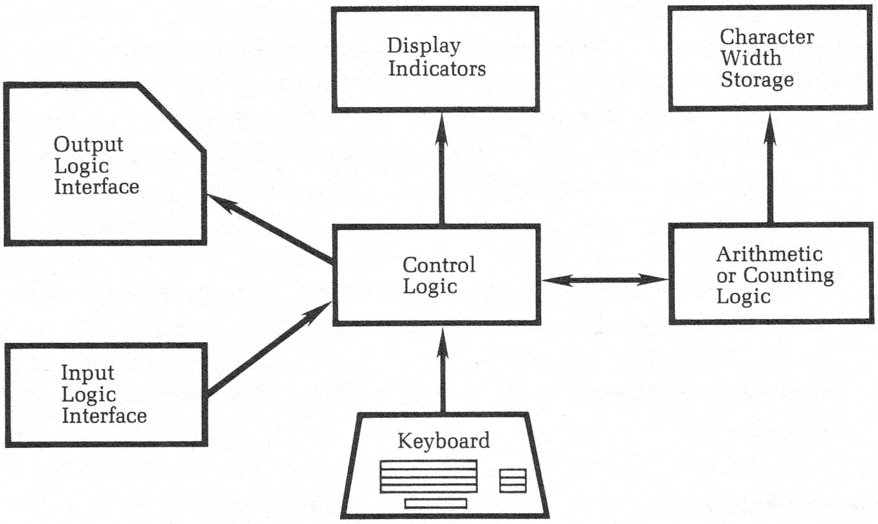


Figure 10. Basic Counting Keyboard Schematic

counting mechanism and logic of the keyboard. Normally, keyboards count in units and therefore the measure has to be translated from absolute units, such as picas and points, into keyboard units. Stored in the keyboard are the width values of characters. As a key is depressed the appropriate width value is determined and deducted from the line length (measure). This process continues until the operator reaches the 'justification zone.' 'Justification zone' is the name given to the area of a line where a particular piece of text could be justified. The counting information is continuously fed back to the operator on a scale, counter, or indicator. When the justification zone is reached, often an audible warning is sounded. Upon reaching the justification zone, the operator decides where to terminate the line. This includes the insertion of a hyphen, should it be necessary, to break a word to improve the spacing in the line.

B. TYPEWRITERS

1. GENERAL ASPECTS

The ubiquitous typewriter is the simplest form of device which has:

1. A keyboard
2. Hardcopy output
3. Storage medium

The key depressions produce characters on paper which are a display in human-readable form and a paper storage record of the information at the same time. The typewriter offers a very direct, simple, inexpensive conversion that is extensively used and has many significant advantages. These advantages include:

1. Unit cost is low
2. Running costs and installation costs are low
3. A large pool of labor is more or less universally available
4. The skills required are limited
5. The labor cost is low compared to other industrial processes.

The output from the typewriter, the typed sheet, can be used as a master to produce the printing plate for urgently-required work, or work which is typographically less demanding. This completely eliminates the subsequent rekeying and setting of text.

However, several disadvantages are encountered with a typewriter system. These disadvantages include:

1. The character set is limited
2. The quality of reproduction is low and limited by the mechanics of the machine
3. Due to the size of characters, the packing density is low
4. The paper sheet record is flimsy
5. Editing or correcting is a difficult procedure often requiring the retyping of a complete sheet

2. STORAGE MEDIUM

To overcome disadvantages 4 and 5 above, typewriters have been interfaced to devices which store information on:

1. Paper Tape
2. Magnetic Cassette
3. Floppy Disks

These methods all improve the storage situation and provide compact, durable, alternative methods to the normal paper sheet. Most typewriters that can store the text on a medium other than the typed sheet, can also be 'driven' to produce hardcopy by the text or data on the storage medium.

The 'playing back' of the stored text by-passes the typewriter keyboard and produces hardcopy in the normal manner. Using this technique of play-back, text can be edited from previously produced and edited hardcopy. This process eliminates the need to retype text which has reasonable alterations or positional movement within the main body of text. Heavy editing and manipulating of text is still cumbersome with this type of system. The generic term 'word processing' is applied to such typewriter systems.

To use the typewriter with a typesetting system, the storage medium (other than the typed sheet) can be read using an appropriate reader, i.e., paper tape reader, cassette reader, floppy disk reader (drive).

The following typewriter problems still remain:

1. The inherent limitation of the typewriter character set is not adequate to exercise the full capability of the typesetting system without extensive function shift codes.
2. The coding structure used on the typewriter system is normally unique to that manufacturer. Consequently, software has to be written to convert the typewriter code into the typesetting code.

With few exceptions, typewriter word processing systems are designed to be self-complementary and do not work easily with other manufacturers' systems. Typewriter systems are standardized by the manufacturer and it is normally impossible to get a sanction or means to make the most minor or trivial change. It is, therefore, the typesetting system which has to be made capable of accepting input from a typewriter word processing system.

3. OCR EQUIPMENT AND TYPEWRITERS

One further alternative does exist for using typewriters with a typesetting system. This is the more usual way of taking the output of the typewriter (hardcopy) and converting it to machine-readable form through an Optical Character Recognition (OCR) scanner.

The OCR equipment will read the hardcopy and translate the human-readable text into machine-readable form. An OCR unit contains the following elements:

1. A light source and a method of displacing the light beam (scanning) over the text to be scanned
2. A method of translating the reflected light into an electrical signal (photocell)
3. A method of comparing the 'read' character image with stored 'master' characters to achieve identification

The light is projected onto the text to be read and the reflected light is detected and

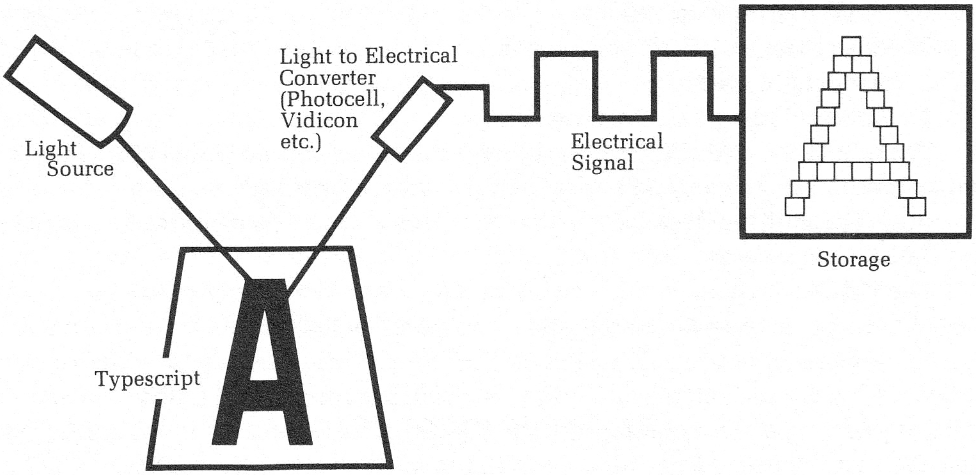


Figure 11. Basic OCR Schematic

converted into an electrical signal; this is generally done by a photocell. The amount of light reflected will depend on whether the light was reflected from a dark area (the character) or a white area (the paper sheet). The amount of reflected light will determine the strength of the electrical signal generated; thus it is possible for the OCR equipment to build up an outline or picture of the character being read. When this process is completed, the read character is compared with master characters stored in the OCR unit. When the nearest match or correlation is made, the character is identified and a character-defining code is assigned to it. Once read, recognized, and assigned a code, normal data manipulation can take place.

The typewriter, which seems to be the logical device to use as the 'input tool' for typesetting in conjunction with OCR, does have disadvantages:

1. The character set and hence the 'codes' available are limited
2. The resultant output or record of data produced is a sheet of paper

Point one above has the same implications for an OCR system as those discussed for keyboards in general in the section "Keyboard Purpose" found earlier in this Chapter. As was stated there, driving a typesetter (or a computer programmed to drive a typesetter) to produce even simple text can require 200 or more character or function codes. Table One, Typesetting Functions, shows a fairly representative list of these codes. Allocating one keyboard key per code results in a very large keyboard, inefficient and difficult for the operator to use. The usual solution is to build a shift capability into the keyboard whereby each key represents two codes. The actual code generated by each key depends on whether the keyboard has been placed in the 'shift or 'unshift' state before a key is depressed. But as with any keyboard using the shift method, an OCR keyboard using it involves several drawbacks:

1. The process involves additional keystrokes
2. As the typesetting becomes more complicated so the method becomes burdensome, prone to inaccuracy, and time-consuming. Keying involves a high de-

gree of skill and accuracy on the part of the operator

3. The typing of text has to be controlled

The keying of instructions is immeasurably more important than keying of text, because one error in the instruction can invalidate the whole of the succeeding text. Additionally, one of the basic advantages claimed for the typewriter is defeated because this procedure demands higher skills on the part of the operator. It is a gross oversimplification of the problem to say that anybody who can type can produce typesetting input. As the operators gain more skills, they will demand recognition and increased earnings as befit their new contribution.

The output of the typewriter now serves two purposes:

1. Hardcopy record
2. Storage and input medium

The success of OCR relies heavily on *controlled uniform* typing. Normally the typing format is 'free' and the precise layout, margins, spacing, presentation, etc., are left to the whim of each operator. This is especially true of creative people; editors, authors, etc., who are credited with little or no understanding of the technical requirements and are reputed to have even less desire to learn them. The comment may be unfair to particular individuals, but as a general rule, creativity and production disciplines do not abide easily together. With OCR, the mechanics of typing must follow these prescribed rules:

1. Margins must be uniform and to the prescribed specification
2. The required type style and size must be used
3. The typewriter ribbon has to give a good impression and be acceptable to the OCR machine
4. Alignment has to be within narrow tolerances within a line
5. Spacing between lines has to be uniform and at least double the normal value
6. Lines must not skew
7. Characters must not touch
8. Characters must not be filled in or smudged
9. Characters must be complete and not broken

The list is long but not unachievable. In in-plant, captive input departments, the control and supervision required can be successfully implemented. If the typewriters are placed in many locations through a building or indeed located in many different buildings, the task becomes increasingly difficult and costly. As control diminishes errors will increase.

Another factor to consider is the requirement for standardization of the typewriters. The OCR machine desires an optimum character shape but will accept or recognize characters that vary within a given tolerance from the optimum. The level of variance or tolerance is dictated by a 'threshold level' set in the OCR machine. For example, a line four units wide is the optimum width. If a typewriter is producing light or heavy characters (three and five units wide respectively) and the threshold is set at ±one unit, the OCR machine will still accept and recognize the lines. If the lines exceed the threshold set in either direction, they will be rejected and not recognized. It is obviously easier to monitor typewriters in close proximity to insure they produce copy that falls within the accepted tolerances set by the OCR machine. The chances of standardization are also improved if the typewriters are of the same make, model number, vintage and general performance. The lower the total number of typewriters, the higher the probability of achieving a standard within which all typewriters will fall.

The paper and ribbon used should be standardized to meet the requirements of the OCR machine. The ribbon repeatability and consistency is important together with its 'color'. OCR machines utilize a particular segment of the spectrum, not always the visible portion, and the ribbon should be selected with this property requirement in mind. The paper's florescence, gloss, opacity, friction, curl and stiffness are important both from the point of recognition and for paper handling. Care should be taken to insure that the OCR paper handler

1. Is accurate
2. Does not skip
3. Does not double feed
4. Does not skew
5. Is not easily jammed
6. Does not place undue restriction on the electronic portion of the system

The typed sheet is cumbersome and difficult to edit. Moving sentences, paragraphs or blocks of text, even without correction, is a slow, laborious task and often means retyping. Ideally, the OCR unit should be regarded as a 'wide (typed character) paper tape reader'. OCR is a fast, inexpensive method of taking source data and getting it into a typesetting system for subsequent typographic formatting, editing and correcting. For this task the typist is required to learn the minimum of additional skills to be able to produce typed text for an OCR unit. Editing, correcting, or adding complex typographic instructions should not be attempted on the typewriter. If the OCR machine can translate the input coding structure into the code structure required by the typesetting system for nominal additional changes, all well and good. Essentially the OCR should be treated much like an elegant paper tape reader.

There are sucessful OCR installations for news and classified ad copy within the newspaper industry. Newspapers are particularly suited because

1. Control can be exercised; newspapers are normally printed and published in the same building
2. The format requirements are defined

There are many good examples in the newspaper industry of how to successfully apply OCR in the production of news text and classified advertisements. An OCR for input and a VDT (video display terminal) for edit is an excellent combination.

C. VISUAL DISPLAY TERMINALS

1. INTRODUCTION

A Visual Display Terminal (VDT) consists of three basic components:

1. A keyboard
2. Logic circuitry and/or memory
3. Cathode Ray Tube (CRT) display screen

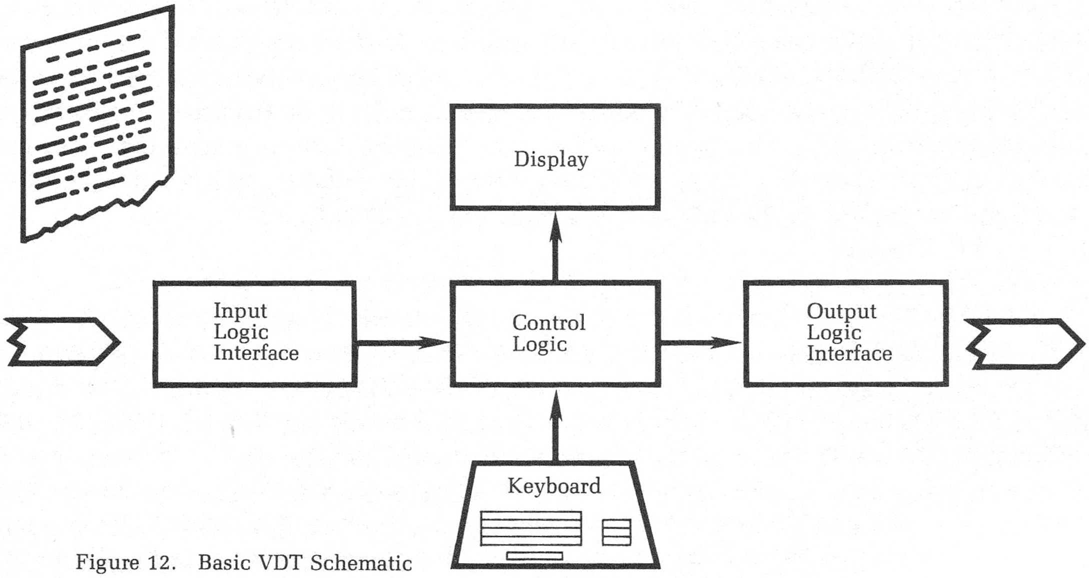


Figure 12. Basic VDT Schematic

To illustrate the operation and use of VDT, we will first consider a stand-alone unit. The term 'stand-alone' implies that the unit has sufficient intelligence to operate, however limited, in its own environment. A typical stand-alone unit consists of:

1. Paper tape reader
2. Paper tape punch
3. A keyboard
4. Logic circuitry and/or memory
5. Cathode Ray Tube (CRT) display screen

The paper tape input can be tape previously generated on a VDT terminal or any other source, which has to be verified or edited prior to the next stage of production. The tape is read via the paper tape reader, into the memory of the terminal where it is stored. Simultaneously, characters are displayed on the screen which conform to the codes read from paper tape. The terminal's first task is, therefore, to translate the machine codes on the paper tape into a form that can easily be read by humans; this is done very simply. The resultant information is displayed on the screen of the VDT and gives a very clear and concise image of the characters contained in the paper tape, but it can have restrictions when graphically presenting all of the information contained in the paper tape. Ideally, the screen of the VDT should present the text or data contained in the paper tape as closely as possible to its appearance when it is set by the typesetter. This is not entirely possible because the flexibility of even the simple typesetter far exceeds that of a VDT; the typesetter is inherently more accurate than a VDT.

2. CHARACTER SET

The character set or repertoire of characters that the VDT can display is limited to

128 or at most, 256 characters. Phototypesetting machines can have a large number of styles, (roman, italic, bold, bold italic condensed, expanded, etc.) and many different designs; (Baskerville, Times, Royal, Clarendon, etc.) All these variations, which can be readily discerned on the output of a phototypesetter, have to be displayed on the VDT screen with one design of character preceded by a character(s) which indicates a change of the typeface and typestyle and has to be interpreted by the operator as such. An example is shown indicating Times Roman (TFI) and Times Italic (TF2).

TFI The text
TF2 The text

The two lines of text on the screen are shown uniformly but are known to be different typefaces because of the command or function codes which are displayed.

It is clear that a terminal is unable to graphically show a representation of text as it will appear when typeset. It is also clear that to be able to check, verify, and decipher the information shown on the screen, all information should be displayed. A 'code for code' relationship should exist between the text and the functions shown on the screen, and the data and commands stored in the tape. Many techniques are used to make the presentation on the screen as clear as possible so that the operator has the minimum of difficulty in deciphering the information. Function codes can be clearly indicated by displaying them in a distinct form, i.e., brighter characters, reversed video, etc.

Although falling short of the typesetter with regards to flexibility for the display of graphics, the VDT is infinitely more attuned to the requirements of the operator than any other device currently used for input. It is inherently more expensive than other input devices although this is changing rapidly with the falling cost of electronic components.

3. EDITING AND VERIFICATION

What the VDT lacks in terms of display finesse it more than makes up for in flexibility, editing, and verification. All other types of input records store text in blocks and require a considerable amount of redundant keying when the order or sequence of the text is altered. On a typed sheet, if a block is to be moved to a position three lines above its present position, the sheet has to be cut and the text placed in the order required or else the page must be retyped. The more difficult the block, the more intricate and time-consuming the process of defining the block, moving, relocating and closing up the text. On paper tape, information is stored serially and it is a difficult, time-consuming business to search out the position in the text required, then add or delete text. On a VDT, once the text has been read into the memory, the operator has complete freedom to insert or delete text at any point with the minimum number of keystrokes and with immediate verification of the editing carried out. If the operator wishes to delete a character, he positions the light guide or cursor on the screen over the character he wishes to delete and presses the command key. The instruction from the operator via the keyboard deletes the character from memory, rearranges the text (closes-up), and immediately displays the result on the screen. The effect is to allow the operator to change the information in the memory via the keyboard and see almost instantaneously the result on the screen. The screen is the operator's 'window' to the memory of the machine. With this approach the operator can interact with the system; if he does not like what he sees on the screen then he can change the instructions, via the keyboard, until he is satisfied with the result. The number of keystrokes necessary to position the cursor and perform the editing is minimal and the verification can be made immediately on the screen. No other method allows such rapid, accurate manipulation of text.

D. COST OF INPUT SYSTEMS

The final matter to be considered is cost. Keyboards or perforators are largely electromechanical. The technology has been exploited over a number of years and the price is relatively stable. The conventional input/output devices, paper tape readers and punches, are well-proven. Unfortunately, because they are electromechanical in design, the unit price is relatively high and they give poor performance compared to relatively modern devices such as cassettes, floppy disks, etc. The electromechanical devices are not readily accepted outside the composing room environment.

Typewriters are relatively inexpensive and are readily accepted in areas outside the traditional composing room. For the printing and publishing industries, the typewriter has attractions as a production tool if used in conjunction with an OCR unit.

The VDT approach offers the opportunity to 'capture' keystrokes at the source and eliminate much of the rekeyboarding normally carried out. The limited character set of the typewriter and the controlled standards of input required by the OCR unit necessarily limit the application of typewriters and OCR. The unit cost with OCR is the typewriter plus a portion of the OCR cost. This unit cost can be very competitive with other methods of input on straight or repetitive matter.

The Visual Display Terminal has the best editing and 'interaction' capabilities. This allows rapid verification of corrections. In the past, the VDT as a source generator has suffered from a high price which has prevented it from being considered extensively as an input device. Now, however, the unit costs have been substantially reduced since the new electronic components have become available. Even in areas like classified advertisements, where an obvious application for OCR existed, VDTs are now very competitive.

E. INPUT UNITS ON-LINE

1. INTRODUCTION

Up until now we have considered 'off-line' input. That is a unit which generates or edits information and then stores the information on paper tape, magnetic or cassette tape, or floppy disk. The text or data is then physically transported to the next stage of the process and the text is read from the storage medium into the computer or phototypesetter.

Once the volume of text to be handled exceeds a certain amount, it becomes worthwhile to put the input device 'on-line' with a system. This means that the input device is electrically connected to the subsequent unit or units in the process. This gives several advantages:

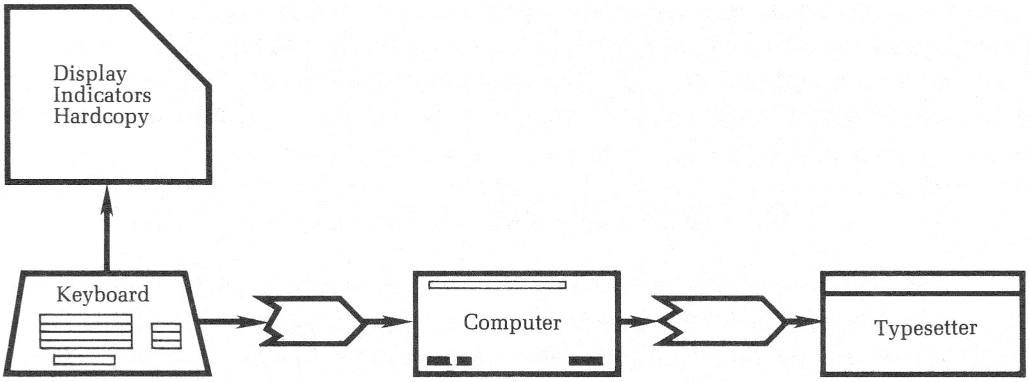

Display
Indicators
Hardcopy
Keyboard
Computer
Typesetter

Figure 13. Paper Tape Off-Line System Diagram

1. Eliminates use of raw material (paper tape, etc.)
2. Allows rapid transfer of information
3. Opens up the possibility for interactive or two-way communication between the input device and the subsequent process

The connection or interface between the two units requires a physical connection by cable and plug, and a modification to each unit to enable them to 'talk' to each other. The interface normally consists of hardware and software. The on-line approach has a considerable one-time cost. The off-line systems have recurring material costs which seem to increase on a monthly basis.

2. KEYBOARDS

A keyboard on-line to a computer or phototypesetter eliminates paper tape and offers a more rapid turnaround of copy. If two-way interaction is desired, then, the keyboard has to have a means of displaying the information received from the computer. A

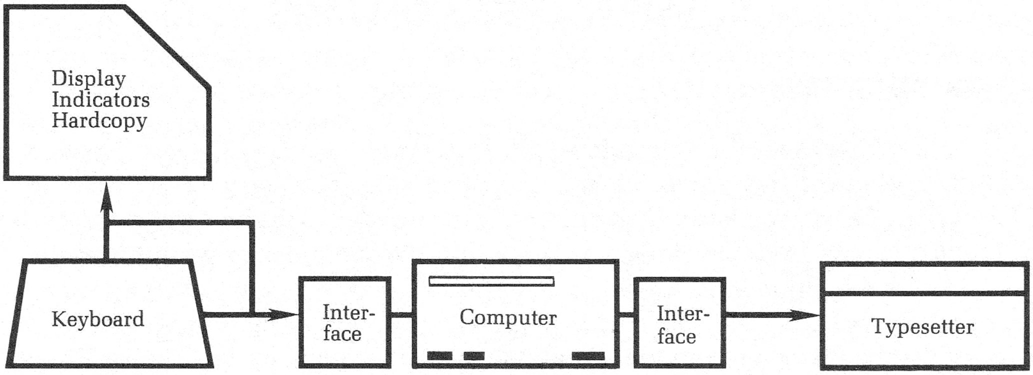

Display
Indicators
Hardcopy
Keyboard
Inter-
face
Computer
Inter-
face
Typesetter

Figure 14. On-Line System Diagram

special typewriter or a printer can be used to operate in conjunction with the keyboard. Although working with the keyboard, the printer is controlled by the computer.

In its simplest form, text is keyed on the keyboard and pulses are generated and transmitted to the computer. Here they are stored and simultaneous instructions are sent to the printer to reproduce the characters just keyed. As far as the operator is concerned, as he depresses the letter 'Q' on the keyboard, a letter 'Q' appears on the printer.

The record on the hardcopy is the operator's 'window' on what he has produced and stored in the computer. By defining a line and a position within that line (addressing) with suitable instructions, the operator can correct errors made in the initial keyboarding. Once the correct location (address) in the text stored in the computer has been reached, the modifications can take place quite easily. The cumbersome and time-consuming tasks are 'talking' to the computer through the keyboard, and referencing locations and addresses which are indicated on the hardcopy.

3. MULTIPLEXORS

A small modification to the operational procedure enables the efficiency of the system to be improved but does not affect the basic concept as far as the operator is

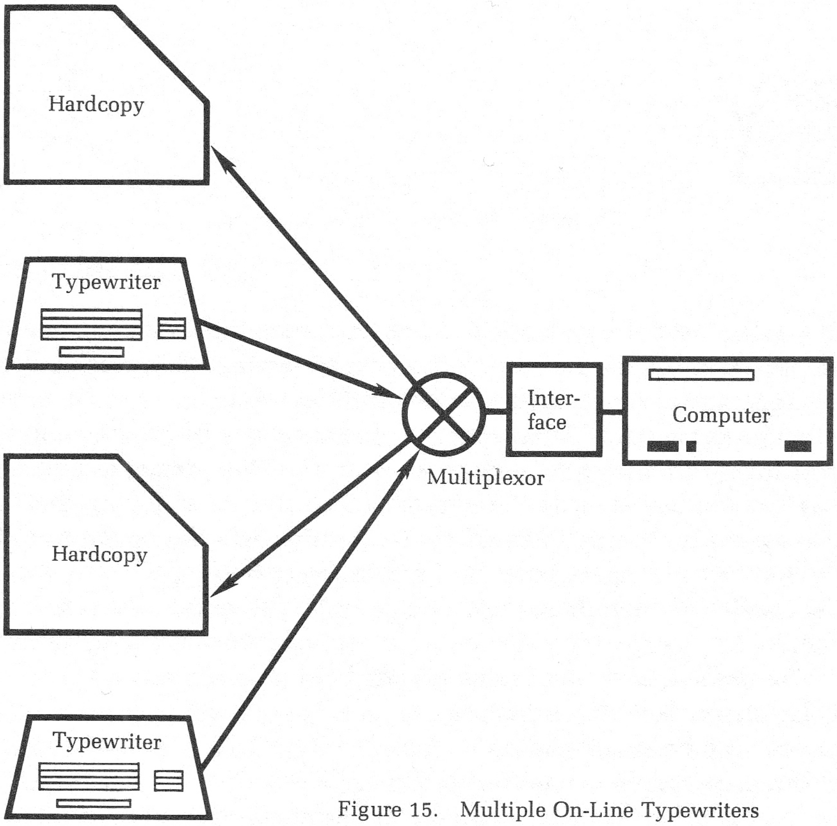


Figure 15. Multiple On-Line Typewriters

concerned. The speed of the computer is infinitely faster than the speed of the operator and the speed of the printer. To maximize the usage of the computer, a device is used by the computer which can look at or scan the input from many keyboards and output to several printers during one second. These devices are commonly referred to as multiplexors.

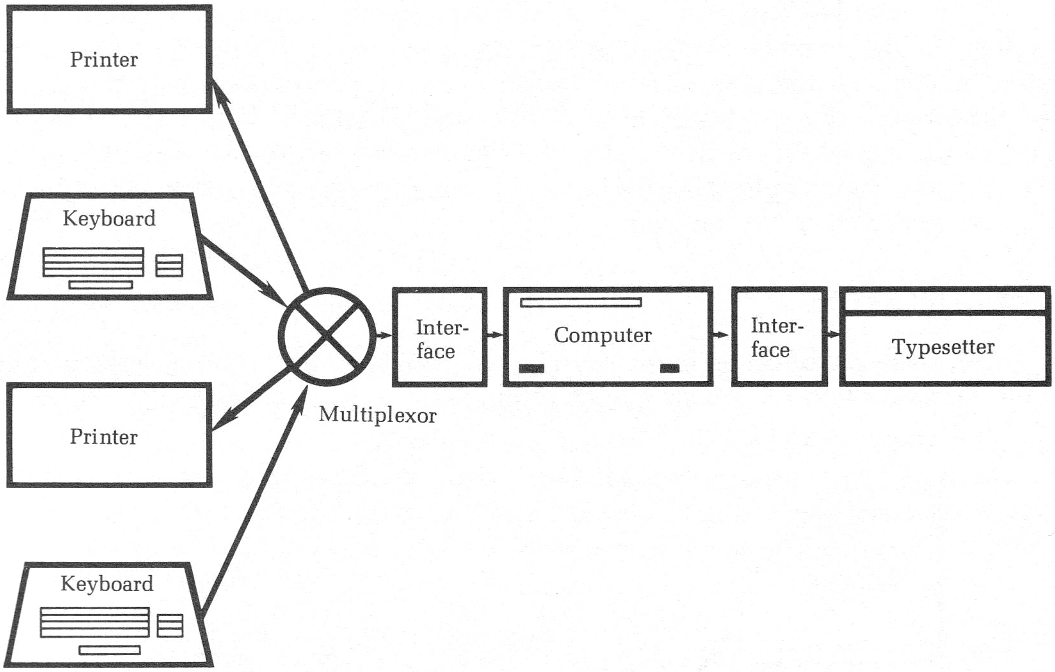


Figure 16. Multiple On-Line Keyboards

The multiplexor allows more than one peripheral device to talk to the computer. Because the computer is performing each function so rapidly, the operator does not know that he is sharing the computer with a number of devices.

Although in practice a small amount of storage may be provided in the keyboard and printer, the main working storage is in the computer. For each operation the keyboard or printer has to communicate with the computer. The number of devices that can talk to or access the computer and respond rapidly enough to satisfy the operator is the limiting factor on the number of devices used in these configurations.

The speed at which the computer can reply, the response time, is governed by many factors.

1. The number of devices to be serviced
2. The response time of devices
3. The speed of transmission of data
4. The speed of the computer software
5. The buffering (storage) available in peripheral devices

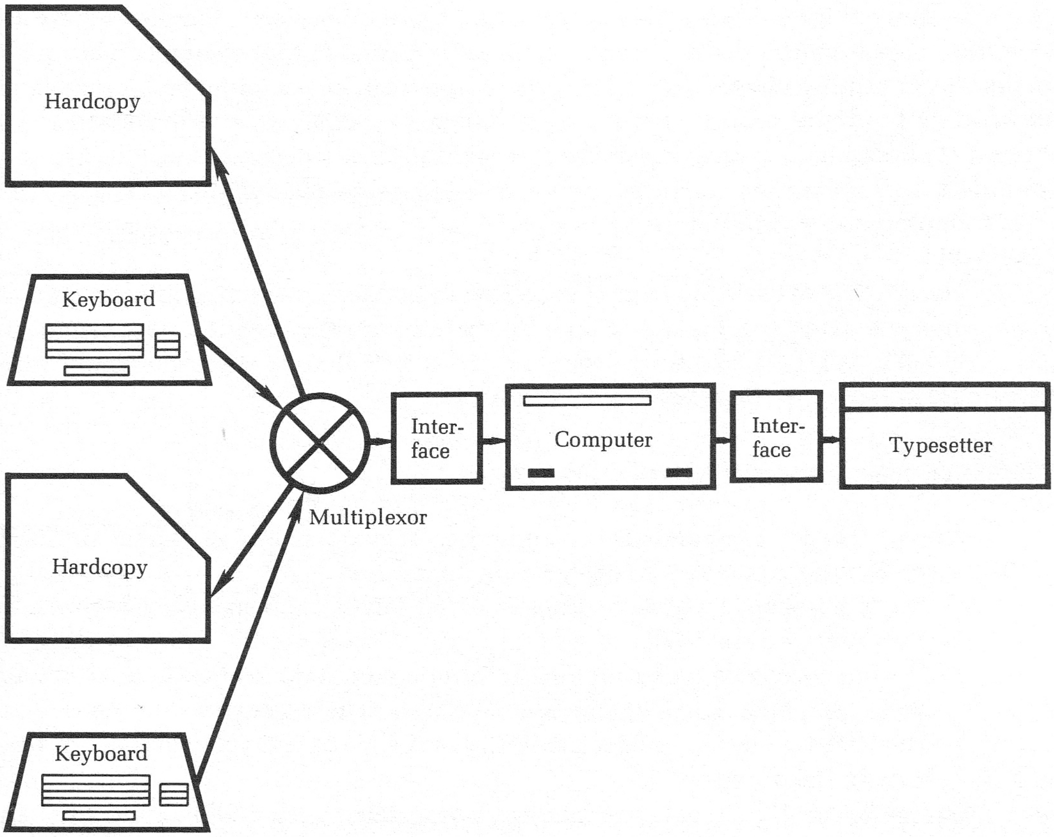


Figure 17. Multiple Typewriters On-Line System Diagram

4. TYPEWRITERS AND OCR

Typewriters can be on-line to a computer. Special typewriters are produced which separate the control of the keyboard and the control of the striker mechanism which produces the hardcopy. These input-output (I/O) typewriters allow the operator to key text and generate the appropriate pulses which are transmitted and stored in the computer. Simultaneously, a return signal from the computer tells the striker mechanism what to print.

The limitation on the use of this type of equipment is the flexibility of the character set and the code set which can be generated by the typewriter.

The best example of this approach is the newspaper installations made by Thompson Newspapers at Reading and Hemel Hempstead in England. The typewriters are interfaced to the computer via a multiplexor. Each typewriter has an area of core storage allocated to it. The input text is stored in the computer which has a justification and hyphenation routine that is used by all the input devices. The subsequent hyphenated-justified text is sent to paper tape punches where justified paper tape is produced ready for setting on the phototypesetter.

In most of these keyboard and typewriter 'on-line' systems, the data enters and leaves the computer through the normal computer input and output channels. This means that the text transmitted by the input device is received by the computer and immediately translated by the input routine into the form (language) required by the computer. The subsequent alteration or massaging of the text is through computer software designed to manipulate the information stored in computer language. When completed, the information is then processed by the output routine and translated back into the language required by the device to be driven.

The purpose of the I/O routine is, therefore, to translate in-coming information into the computer language and the out-going information into the output device language.

When typewriters are used in conjunction with OCR units, direct communication between the system and the typewriters is possible.

5. VISUAL DISPLAY TERMINALS (VDT)

When VDTs are used on-line to a computer, they operate in a manner similar to typewriter or keyboard systems. The major differences are:

1. The high speed at which the transfer of information can take place between the computer and the VDT.
2. The improved response time allows the operator to interact with the computer. Each instruction keyed by the operator is shown immediately on the screen.
3. The VDT screen has greater flexibility in the graphic display and hence feedback to the operator.

To function, a VDT must have a memory associated with it which will store and refresh the characters displayed on the screen. This means that the communications between the VDT and the computer need not be character- by-character but can, in fact, be in larger blocks. With this method of transmitting blocks of data, several advantages occur:

1. Higher transmission speeds
2. Less frequent interrupting and use of the computer

Because the VDT is on-line to the computer, control of the VDT can be either by the computer continually scanning the VDT memory and carrying out its instructions as required, or by building logic into the terminal to make it independent of the computer for certain operations.

The amount of logic in a terminal determines whether it is an 'intelligent' or an 'unintelligent' terminal.

In the simplest application, a VDT consists of a keyboard and a CRT (Cathode Ray Tube) TV screen. Most of the editing and control logic is part of the computer. It therefore follows that the computer has more work to do and has to translate the information and format it in a way that will be acceptable to the display on the terminal. It is apparent that the simpler or less intelligent the terminal, the more work the computer has to do.

Originally, maximum use had to be made of a computer because it was extremely costly. Due to the reduction in the cost of electronic components and the improved performance over the last decade, this principle no longer holds true. The price reductions on computers and memory now make it possible to have 'distributed logic'. This implies

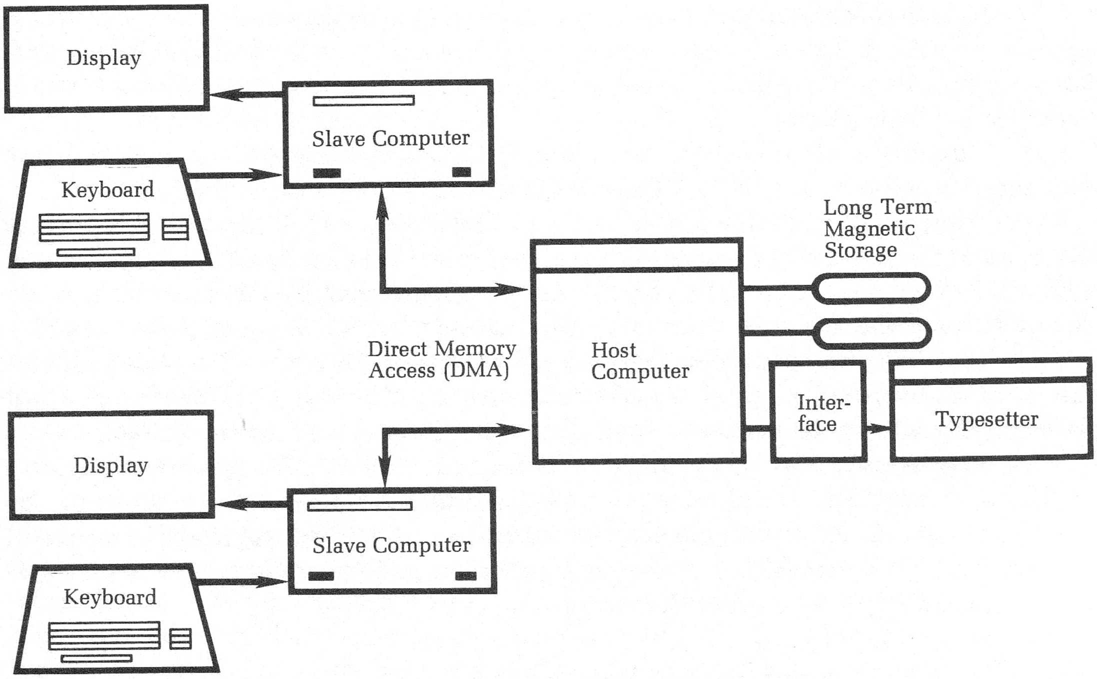


Figure 18. Basic Schematic for Distributed Computers

that the logic or computer power does not reside in one place. In a VDT system the logic in a VDT unit can be built up so that the minimum communication is necessary with the computer. Ultimately, each VDT or peripheral device can have its own computer and be connected to the main computer. The peripheral system or slave computer would then talk to the main or host computer. There are definite advantages to this type of architecture:

1. Access time for essential, frequently-used tasks is very fast; one computer is dedicated to the task.
2. Minimal interruptions have to be made on the host computer.
3. The complexity of programming is reduced because each sub-system has one clearly-defined task to perform.

It is vital that functions such as editing, scrolling, etc., are performed as quickly as possible. The response time on a system which relies on one main computer suffers greatly when a number of complex moves of text are required by several VDTs at the same moment. Although the computer is fast, it must have priorities and can only perform one operation, at a time. The more complex the system's operational requirements, the more complex the software needed to meet those requirements. The performing of many operations rapidly so that each peripheral device is driven as fast as it can go with no lost time due to computer processing is called 'real time' operation. The software required for real time operation is often difficult and complex to produce. It is far easier to assign specific tasks to individual computers, which on completion of a specified task, can pass the result on to the next computer.

As an indication of the complexity of typographic programs, an average justification routine will take between one-fourth to one-half second to justify and hyphenate a line. Not a very long time, but in that same period the computer most probably executes 30,000 to 40,000 single instructions.

If ten VDTs, all on-line to a computer, want text justified at the same instant, the maximum response time will be 2½ to 5 seconds wait per line of justified text.

The normal acceptable wait-time on an interactive system is less than two seconds and as near to one second as possible. If more than one line has to be justified, the waiting time will be longer and during this period the computer cannot be doing any other work. The other item which is time-consuming on a terminal system is moving text.

The single item that has prevented the widespread use of VDTs is the high unit cost. This has been, and is being reduced almost monthly. The cost of VDTs based on a unit price* is now extremely competitive with any other input device on the market.

One disadvantage which still currently exists is that the VDT, to be effective, has to be tied by an electrical umbilical cord to the computer. This places restrictions on the location of units and makes the provision for transmission facilities over long distances still very expensive. The development of acoustic couplers and improved telephone line systems will improve this aspect in the future.

F. INPUT EQUIPMENT EVALUATION

1. GENERAL CHARACTERISTICS

The problem with evaluating input systems is that there are always several ways of achieving the end result. The aim should always be to achieve the end result as economically and efficiently as possible. Considerations must include:

1. Obtaining the maximum *correct* output from the operator
2. Having the minimum operator skill requirement necessary for producing the work envisioned
3. Offering the maximum service to the customer for which he will pay
4. Spending the minimum amount of money on the system required to achieve 1-3 above
5. Insuring that there is a market for the output of the system which can be sold profitably

2. TYPE OF WORK DEFINED IN CATEGORIES

The first step in equipment evaluation is to categorize the work which will be placed on the system. Divide it into categories with respect to:

1. Simple text
2. Complex text

---

*Unit price is the cost of the VDT or TV display plus a portion of the computer system including hardware and software that is required to operate the VDT.

3. Simple display
4. Complex display
5. Tabular setting
6. Simple mathematics
7. Complex mathematics
8. Simple chemical formula
9. Complex chemical cormula
10. Area make-up
11. Page make-up (pagination)

Then calculate the percentage of work to be produced in each classification as a percentage of the total volume. Samples of these categories are shown in Figure 19.

Finally, estimate the current cost for each work category produced on the current system. On occasion, local factors or normally unrelated political requirements will play a part in drawing up this evaluation. For example, a forecasted lack of a particular skill can hasten the introduction of a system designed to replace that skill at a higher price.

The judgment has to be made by management on the most effective investment: whether to increase the labor rate, no matter how high, to make the acquisition of the skill attractive, or invest in a system. Not infrequently in the printing and publishing industry throughout the world, demands by organized labor and the capitulation to labor demands on the part of management have resulted in inefficient use of equipment. Often these inefficiencies prevent the profitable use of the equipment. This significant factor has to be taken into account.

To assist the reader, the following definitions are offered for the different categories of typesetting. These definitions should not be treated as sacrosanct but should be modified and adapted to more precisely meet the house requirement. The estimated current cost, labor situation, improvements, and additional expenditures which will be necessary, can only be derived from each category investigated. (To assist the reader, a typical example of actual cost comparisons is shown in Table Two.)

3. THE BASIC TYPESETTING CATEGORIES

The basic categories are defined as follows:

1. *Simple Text.* Text that has no more than two column widths in a galley. Has no more than three point sizes, no intermixing within a line, four different leading values, and only mixes text of the same size but different typefaces or styles within a line. The character set required conforms to the characters contained in the standard character set of the house.

2. *Complex Text.* The same as simple text except that intermixing of sizes within a line and non-standard or pi characters are required.

3. *Simple Display.* Text that has three or more column widths in a galley. Has three point sizes or more in the galley but does not require point sizes to be mixed within a line. Simple display has five or more different leading values and mixes text of the same size but different typefaces or styles within a line. The character set required conforms to the characters contained in the standard character set of the house.

4. *Complex Display.* The same as simple display except that intermixing of sizes

1. Simple Text

Gallium occurs in very small amount in **zi**
yrite, bauxite, and **kaolin** of certain localiti
nillion is present in Oklahoma zinc ores.
ium from zinc flue dust is effected by solutior
f **hydrochloric acid,** addition of potassium
ion to remove **germanium.** When the resic
ulfate, fractional electrolysis of the sligh
noves **zinc,** and the gallium is obtained alm
Gallium trihalides include the trifluoride,
ind the trichloride. The trichloride is readi
he metal with **chlorine** or **hydrochloric acid**
ind like **aluminum chloride,** is effective as
rganic reactions. Both the trichloride an
limeric in the vapor state. Other known tr
ounds are the sesquisulfide, sesquisulfate
alts analogous to the **alums**), trinitrate, nitrid
s polymorphic like alumina), and trihydroxid

2. Complex Text

letal of main group 3 of the **periodic table.**
tomic weight 69.72. Symbol Ga. Natura
69, 71. **Electronic configuration** $1s^22s^22p^63$
nic radius Ga^{+3} 0.65 A. Gallium metal
structure with one nearest neighbor at 2.
two at 2.74_2 A and two at 2.80 A. First **ioni**
ev; second, 20.43 ev; third, 30.6 ev. **Oxi**
$Ga^{+3} + 3e^-$, -0.52 v; $Ga + 4OH^- \rightarrow H_2G$
22 v. The melting point is 29.78° C, the
and the specific gravity, 5.91 (20° C).

3. Simple Display

Compact 5.78 Cu. Ft.
Coldspot Refrigerator

Regular
$199.99

$169

Ideal for small kitchens, den, bar. Manual defrost refrigerator and freezer. 2 adjustable shelves, crisper cover serves as third shelf. Manual defrost. In our Refrigerator Dept.

4. Complex Display

STOCK YOUR FREEZER

WHOLE 14 TO 20 LBS.
STRIP
STEAK
SALE

CUT TO
YOUR
ORDER
$1 69
Bone
In
lb

WHOLE
RIBS
OF
BEEF

22 to 30 lbs.
Cut To
Your
Order
$1 29
lb

5. Tabular Setting

Description	Price Per Page	% Profit	Pages Per Hour
Simple Text	$10	5%	6
Simple Display	$20	8%	2
Complex Maths	$40	15%	1

6. Simple Mathematics

$$B = \mu H = 4\pi I + H$$

$$I = \kappa H \text{ (or } \kappa = I/H)$$

$$\mu = 4\pi I/H + 1 = 4\pi\kappa + 1$$

$$\kappa = (\mu - 1)/4\pi$$

7. Complex Mathematics

$$\left[1+\frac{v^2A^2}{32\left(\Theta_0-\frac{v^2A^2}{64}\right)}\right]\exp\left\{\frac{32i}{vA^2}\left(\Theta_0-\frac{v^2A^2}{64}\right)\right\}$$

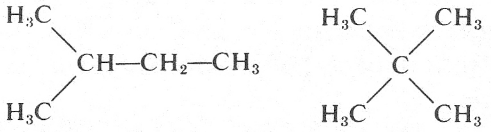
$$\left(\int_{R^n}\left|\frac{\partial^q}{\partial x_1^q}(uv_\lambda)\right|^2 dx\right)^{1/2} \geqq \left(\int_{R^n}\left|u\frac{\partial^q v_\lambda}{\partial x_1^q}\right|^2 dx\right)^{1/2} -$$
$$-\left(\sum_{i=1}^{q}\binom{q}{i}\int_{R^n}\left|\frac{\partial^i u}{\partial x_1^i}\,\frac{\partial^{q-i}v_\lambda}{\partial x_1^{q-i}}\right|^2 dx\right)^{1/2},$$

Figure 19. Samples of Setting Categories

8. Simple Chemical Formula

$Na_2[Fe(CN)_5NO]$
disodium pentacyanonitrosylferrate
$K_3[Fe(CN)_5CO]$
tripotassium pentacyanocarbonylferrate
$K[Co(CN)(CO)_2(NO)]$

9. Complex Chemical Formula



10. Area Make-up

SOME OF THE MANY
OUTSTANDING FEATURES:

- Press widths 20″, 26″ and 32″.
- Offset units wet, dry or combination.
- Dahlgren dampening system as standard.
- Speed 1000 f.p.m. with accurate register.
- Rubber letterpress units with micrometer adjustment.
- Front and reverse printing on all units.
- Numbering for M.I.C.R. or O.C.R. and file hole punching unit.
- Rema-line punching, cross perforating, slitting and sheeting.
- Modular design, walk-in base, side drive with individual gear boxes.

11. Page Make-up (Pagination)

Beauty Salons

Alzada's Beauty Nook 263 Court Lac.....524-6866
Arline's Beauty Shop 131 Main Tilt......286-4300
Barbara's Beauty Salon 22 Green Bris....744-2798
Beauty Bar W Main Ashd..............968-3379

BEAUTY BOX

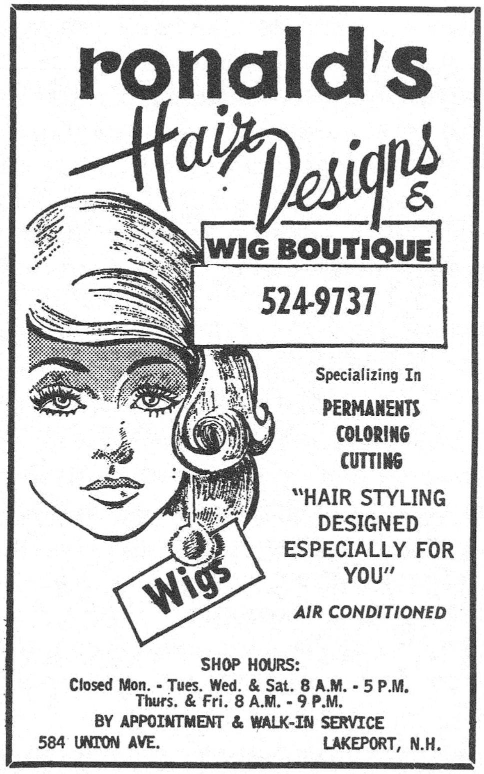
IN PLYMOUTH
IT'S THE BEAUTY BOX
COMPLETE BEAUTY CARE
ALL TYPES OF WIG SERVICE
WALK-INS WELCOME
47 Main Ply...................536-1806

Beauty Lounge Main N Con............356-2270
Bella's Beauty Salon Lake Tarleton Rd Wrn.764-2451
CANDY'S BEAUTY SHOPPE
728 Union Av Lakeport..........524-3165
Carol's Beauty Shop
Daniel Webster Hghwy Mrdh........279-6531
Cin-derella Style-O-Rama 22 Highland Ply.536-1959

COUNTRY BEAUTY SALON

JOANNE DUSTIN
COMPLETE
HAIR STYLING
WIG SERVICE
OPEN DAILY
EVENINGS BY APPOINTMENT
Flaghole Rd E Andover...........934-5336

DONNA'S HAIR STYLING Main Mrdh......279-4580
Doucet Marie Anne 19 Franklin Fkln......934-2069
Duchess Beauty Shop
Salisbury Rd Fkln..............934-5244



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CUTTING

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Thurs. & Fri. 8 A.M. - 9 P.M.
BY APPOINTMENT & WALK-IN SERVICE
584 UNION AVE. LAKEPORT, N.H.

Figure 19. Samples of Setting Categories

within a line and/or non-standard or pi characters are required.

5. *Tabular Setting.* Any text that has more than one column width in a line. The term should be added to the previous descriptions 1-4, i.e., if tabular setting occurs and meets one or all requirements laid down for simple display, the table should be referred to as 'simple display table' irrespective of the description of text that precedes or succeeds the table.

6. *Simple Mathematics.* Setting that requires mathematical characters and symbols which can be normally acquired and does not require excessive calculations on the part of the operator of the system. As an example, on most systems mathematical characters which are 'standard' to the system can be set with no additional calculation on the part of the operator or system through a line. Equally, two-line mathematical expressions can normally be set quite easily:

$$\frac{a + b}{c} = d$$

Figure 20. Two Line Mathematical Equation

The definition of normal[*] varies from manufacturer to manufacturer. The implication is that 'standard' mathematical symbols will be used.

7. *Complex Mathematics.* Setting that requires an extensive range of characters and signs not normally standard to the manufacturer's equipment. Please note that standard (normal) to the manufacturer's equipment does imply that although the house specializes in math settings, signs regarded as 'normal' in-house may not be regarded as 'normal' by the manufacturer. Setting that requires considerable calculation and/or mark-up by the operator and/or system is also considered complex.

8. *Simple Chemical Formula.* Setting that requires chemical symbols which can be 'normally' acquired from the manufacturer and placed in the text without excessive calculation on the part of the operator or the system.

9. *Complex Chemical Formula.* Requires an extensive range of characters and signs not normally standard to the manufacturer's equipment. Setting that requires considerable calculations and/or mark-up by the operator and/or the system.

10. *Area Make-up.* A defined portion of setting containing one or more elements that constitute the block or area that when set, requires no positional adjustment within its borders prior to the printing surface being produced. Illustrations, etc., may be added and the block of text positioned in relationship to other parts of the work.

11. *Page Make-up (Pagination).* The setting of all text which will constitute the text and references found on one leaf of a book, magazine, newspaper or similar article in the correct location. The result will require no positional changes to the text within its own borders but may have illustrations or other non-text information added. The page will be positioned with respect to other text in the work when the printing plate is produced.

---

[*] There are basically three categories of material that can be obtained from the manufacturer, defined as follows.
Normal: That which is selectable by the customer but supplied with a basic machine.
Standard: That which exists in the manufacturer's repertoire but can only be obtained by paying added charges.
Non-Standard: That which the manufacturer must specially prepare and involves added charges.

4. SUITABILITY

Having ascertained and categorized the type of work the electronic system must produce, the electronic system should be studied to ascertain the:

1. Equipment suitability
2. Equipment acceptability

After the work categories are determined, the following characteristics should be determined:

1. Character set
2. Pi characters
3. Typefaces and styles
4. Point size range
5. Maximum line length
6. Leading movements
7. Source of copy (handwritten, typed, etc.)
8. Standard of presentation of copy
9. Repeatability of copy standards
10. Preparation of copy requirements
11. Make-up of copy requirements
12. Service (on the equipment)

The input device or system is required to:

1. Allow fast, accurate keyboarding
2. Place the minimum demands in terms of special skill on the operator
3. Allow simple correction
4. Provide rapid verification of changes
5. Provide adequate proofing

Selected test portions of text should be produced on each system and the complexity of the production operation evaluated.

Those categories of text that form a very small percentage of the total volume produced may well suffer because it is pointless to over-specify a system for the sake of work which will not have a sufficient return to justify the additional expense. It should be noted that as a general rule, a higher return is possible on more complex work due mainly to the reduction of business competition and the ability of an electronic system to simplify the complex work.

A. KEYING. If the character set is complex and the number of function codes necessary in a line due to point size or typeface or style changes is large, a typewriter is less effective as an input device than a blind keyboard or VDT. If the text is straight forward and repetitive, a typewriter will be entirely adequate, and the additional cost associated with the VDT or blind keyboard will not be required.

B. CORRECTING. Work that needs to be frequently viewed, corrected or edited is usually best handled on a VDT. Equally, if the editing requirement is low, a blind keyboard will suffice.

Concurrent with all these decisions, service on the equipment that will be offered to the printer must be considered. Service is not noticed when good, but is readily apparent when bad. If a prime requirement is the quick turnaround of copy from good typed source data, OCR has a ready application.

If the ability to make extensive corrections at any point during the composing room production cycle is required, then a VDT is to be preferred. All of this needs to be looked at and evaluated in terms of the suitability of the equipment.

5. ACCEPTABILITY

Acceptability of input equipment is determined by evaluating the areas of expertise and training, and politics.

A. EXPERTISE AND TRAINING. Based on the current methods employed, a certain level of expertise will exist within the composing department. This expertise represents a great deal of learning and experience and has an indefinable value until you face the problem of replacing it. A good example is keyboard operators familiar with a given keyboard layout. If ten operators are proficient operators of the Linotype layout, the cost of retraining them on 'Qwerty' layouts could be $4000 per individual. The total retraining cost of $40,000 is the minimum value to be placed on the expertise. Against this should be weighed the predicted likelihood of availability of labor with these two skills.

B. POLITICS. For whatever reason, no matter how illogical, it may be impossible to get a certain piece of equipment accepted by the operators. Alternatively, the union-labor price may be so high as to make the acquisition of the machine impractical. If either situation exists, then no matter what the advantages, the disadvantages override. The primary phase of system evaluation is a logical progression through the steps:

1. Categorization of the type of work to be produced
2. Quantified in terms of:
    a. Percentage of total volume
    b. Percentage of total contribution
3. Equipment evaluated for
    a. Suitability
    b. Acceptability

The next thing to do is to determine the prices associated with the various equipment or systems which can meet the preceding requirements.

G. COST EVALUATION

1. GENERAL CONSIDERATIONS

The following should be calculated:

A. FIXED COSTS
    1. Cost of equipment (hardware and software purchased or financed)
    2. Installation
    3. Additional peripheral equipment (furniture, etc.)
    4. Environmental equipment (air conditioning, etc.)
    5. Building modifications
    6. Training

B. VARIABLE COSTS
    1. Maintenance
    2. Materials
    3. Utilities

C. LABOR COSTS
    1. Direct
    2. Indirect
    3. Premium payments

Offset against:

1. Government tax relief on capital expenditure
2. Government training assistance
3. Any other preferential tax consideration

A calculation should be made based on a known volume of work to be produced over a specified period by the existing system; a similar calculation should be made using the proposed system. This is necessary in order to ascertain the probable outcome in terms of profit using the financial models of Chapter 9. Other factors which have to be considered are:

1. How the fixed and variable costs will be affected over a number of years.
2. The impact of the new system (versus the old) with respect to:
    1. Market development
    2. Increased production
    3. Meeting the requirements of subsequent processes.

Having completed this exercise, a value and expected return can be associated with each alternative. At this point, the persons who have been investigating the matter will have arrived at a preference and perhaps the employees, who will operate the system, will have stated a preference. Employee preference must be considered and it should be borne in mind that it is often difficult to get people to accept choices other than their own. At this point, the pros and cons have to be weighed and a decision made. The decision is usually made by one person. A committee will usually investigate the matter but only one person will make the final decision. This *Guide* will help bring all the elements of the decision process together and make the 'lonely road of decision' easier.

2. EXAMPLES

Table Two, Example of Cost Comparisons, shows the typical cost comparison between an existing hot metal composition system and an electronic composition system.

Table Two. Cost Comparisons Between Hot Metal and Cold Type Setting

	OPERATING YEAR 1974-1975			
	HOT METAL		**ELECTRONIC**	
	$	%	%	**$**
Annual Sales Volume	1,000,000	100.	100.	1,000,000
Factory Payroll (Fixed cost) Salaries	32,000	3.2	3.2	32,000
(Variable Cost) Wages (direct), general factory salaries, payroll taxes and employee benefits.	545,000	54.5	23.	234,000
Materials	45,000	4.5	15.	151,000
Factory Expenses (Fixed Cost) Rent, utilities, insurance, property taxes	51,000	5.1	2.3	23,000
Depreciation	26,000	2.6	7.8	78,000
Factory Expenses (Variable Cost) Supplies, packing, shipping and transportation expense	47,000	4.7	3.8	38,000
Administrative Expenses (Salaries, payroll taxes, employee benefits, bad debts.) Other taxes excluding income and property.	115,000	11.5	11.5	115,000
Sales Expenses (Fixed cost) Salaries (Variable Cost) Salaries, commissions, payroll taxes, employee benefits, traveling and living expenses, advertising and promotion.	72,000	7.2	7.2	72,000
Operating Income	67,000	6.7	28.7	287,000
Other income (expenses)	9,000	(0.9)	(0.9)	9,000
Net income before Income Tax	58,000	5.8	24.8	248,000

The example shown is typical of many of the detailed cost comparisons that have been made between conventional hot metal typesetting and electronic typesetting systems. The principal areas of change are the factory variable cost, payroll, materials, factory fixed cost expenses, depreciation, and factory variable cost expenses. Other expenses may vary but usually not significantly.

Factory Payroll. The most dramatic reduction in expenses caused by utilizing an electronic typesetting system is in the area of direct wages. The reduction shown in the example is by a factor of 2.3 in favor of the electronic system. This represents a reduction of approximately 30% of the total expense. A reduction of direct wage expense is always encountered with the installation of an electronic system. This reduction will vary according tothe complexity of work being produced and the amount of additional salary incentive pay that has to be made for the introduction of the electronic system.

Materials. The materials cost encountered in utilizing a phototypesetting system when compared to a hot metal system is invariably higher. The cost of photographic film or paper and the associated chemicals is not recoverable and is a recurring cost. Photographic material is an expensive commodity without general inflation. Currently there is no indication that the photographic material prices will remain constant over the next few years. There is even less indication that these prices will decline in the next few years. Silver recovery units can be purchased to reclaim the silver from used chemicals which are usually thrown away. As the cost of photographic material and the price of silver increase, these recovery units become more financially inviting. Another great expense increase with phototypesetting is proofing. In conventional hot metal typesetting, galley proofs can be produced very cheaply using low cost materials and equipment. With phototypesetting, a 'photographic' process using electrostatic or diazo techniques has to replace the conventional proofing. This is very much more expensive in terms of material and equipment. The production of a large number of proofs for each item (i.e., in excess of five) can be economically achieved by making a paper offset plate and printing the proofs on an inexpensive paper stock.

Although the material expense increases significantly for the electronic system in the example by a factor of 3.3, the overall increase in the total expense is approximately 10%.

Factory Expenses-Fixed Cost. With an electronic system using phototypesetters, the space required for housing the equipment, personnel, and storage is reduced by a factor of two — reflecting approximately a 3% reduction in total expenses.

Depreciation. The depreciation expense or the equivalent rental or leasing cost is higher with a new electronic system. How much higher depends on the current depreciation value of the hot metal equipment it replaces. In the example, the depreciation cost of the electronic system over the hot metal system is higher by a factor of three. This represents approximately a 5% increase in the total cost for the electronic system.

Factory Expenses-Variable Cost. The expense is reduced for the electronic system principally because the end product, photographic material, is much easier to handle than lead type. The reduction is not significant and is approximately 1% of the overall expenses.

Summary: it can be stated that the most significant cost reduction brought about by utilizing an electronic system is in payroll. More important, payroll is a variable cost which can be affected by management control. Factory expenses, both fixed and variable, are reduced slightly when utilizing a system. The major increases in expense, when a system is used, are materials and depreciation (or its equivalent). Over all, a substantial reduction in expenses can be expected with a management opportunity for more accurate budget control because the variable costs rather than fixed costs are reduced. This variable cost reduction advantage can turn into a disadvantage if the volume of work falls below the minimum level required to generate sufficient income to meet the fixed expenses.

One factor not shown in the example is the possible salary repercussion throughout the plant or factory when a new electronic system is installed. In conjunction with installing an electronic system, labor demands sometimes have created an increase in the whole payroll structure. Substantial increases are sometimes required throughout the entire factory. The salary increases are achieved by personnel directly and indirectly associated with the new process. The revision of the wage structure of personnel directly affected by the implementation of new techniques is to be expected; the necessity of increasing wages to persons not directly associated with the composition system depends upon the prevailing political climate in each plant.

CHAPTER TWO

EDITING AND CORRECTIONS

A. TYPEWRITER

On a standard typewriter, the methods of correction are somewhat limited and quite often cumbersome. In all cases, they are quite time-consuming. The recording (storage) medium is the sheet of paper or hardcopy. If the operator recognizes that an error has been keyed, it is necessary to go back over the incorrect text and erase it. This can be accomplished mechanically by utilizing a typist's eraser. Having deleted the incorrect text, new correct text can be typed in its place. Alternatively, one of many opaquing systems can be used. These preparations, basically a white pigmented solution coated on tape or other medium, allow the operator to overstrike the incorrect text with the opaque material and cover up the black carbon image. The resultant 'white space' created can then be used for the new correct text. Opaque liquid can be used to 'paint' over the incorrect characters; masking tape can also be used to overlay and 'delete' text.

It is important to note that with just the hardcopy as the record of output, and without the interaction of an OCR unit, it is impossible to move, insert or delete blocks of text and rearrange them on an already typed sheet. If text move is required, the complete text has to be retyped.

B. PERFORATORS

When text is produced on a perforator, the text is stored (punched) on paper tape. As the operator depresses a key, the information is punched into the tape. The tape is then advanced allowing the next key depression to punch a character into the tape. The tape emerges in the sequential order in which it was punched. If, when keying, an operator recognizes that an error has been made, it can be corrected. The tape has to be backed up, either manually or by depression of an appropriate tape back up key, until the first incorrect character is aligned with the punch mechanism. The code(s) is then over-punched with the delete or rub-out code (all levels and all possible holes of the tape) which will be ignored by any subsequent reading process. All codes from the location of the first incorrect code to the end of the text are over-punched with the rub-out or delete code, irrespective of whether they are correct or incorrect. The corrected text has to be re-keyed. This process is satisfactory where the operator detects mistakes during the process of keying. The procedure is simple for deleting a single preceding character. The process is not recommended when the operator has to conscientiously review previously keyed text. Alternatively, if a subsequent process (computer or typesetter) is used which can interpret codes, a delete character code or delete word code can be (punched) keyed. This code, when read by the computer or typesetter, will disregard either the previous character or word as specified by the code. This method is faster and more accurate than using the rub-out (of each incorrect code) delete procedure, but does require intelligence in the subsequent process.

C. OPTICAL CHARACTER RECOGNITION (OCR)

1. INTRODUCTION

There are over 110 different models of OCR devices produced by dozens of manufacturers; only a handful are appropriate for the printing and publishing industry. It is with respect to these half-dozen or so units that the following comments are made.

Optical Character Recognition (OCR) devices are important because they offer a solution to the problem of how to enter information into a typesetting system with the minimum re-keyboarding. They enable data to be captured at the source. Text produced on the typewriter can be translated into machine language by the OCR device. Sometimes with little processing, that same text can be used as input to the typesetting system. It has already been pointed out that the key to successful use of OCR is *Controlled Uniform* typing. An OCR device should be regarded as a 'Wide Paper Tape' reader. As a system, it is not well-suited to the editing and correction of text. Its appeal is that it allows typewriters to be used as the initiator of data. The OCR unit should be viewed in much the same way as the paper tape reader: incidental to the process but allowing the required input device to be used.

It follows that the OCR unit should have the lowest possible price and be dedicated to the function of converting typescript into machine-readable form. Additional features should be resisted with the possible exception of code conversion. One manufacturer is already exploiting this policy and is selling his OCR unit as a component unit to other manufacturers who produce the systems. This is similar to paper tape reader manufacturers who primarily sell to systems manufacturers and tend to ignore the end-user market. The success of OCR in this segment of the market is already apparent and there are some fine applications for the technique. The OCR unit has to be considered in conjunction with the input typewriters. The typewriter determines the use and application and is the interface between man and machine. The relative merits and demerits of the typewriter are covered in Chapter 1, Section B.

The OCR requirement for the industry is a page reader. The techniques available are OCR (Optical Character Recognition) and OBR (Optical Bar Recognition). OBR is covered in sub-section 11. In some cases, marks or limited handprint can be read in addition to a standard character set. The OCR unit can be used on- or off-line. Once off-line, the translated text or data can be stored on paper tape, magnetic tape or disk, or floppy disk. In view of the nature of OCR and its application to typesetting, on-line use is recommended where the subsequent process is situated adjacent to the OCR reader. A movable storage medium will have to be resorted to if the text or data has to be transported to the subsequent process. The additional burden placed on the host computer, when an OCR is placed on-line, should be minimal.

2. DOCUMENT HANDLING

Document handling from the input station to the output station is of critical importance. The development of accurate, reliable, and low-cost document handling has been difficult. Bearing in mind that the process is basically electro-mechanical, certain limitations will always be evident. The successful operation of the document handler is also intimately connected to the type and quality of material to be transported. The effectiveness of the document handler should not be achieved at the expense of raising the standards and price of the raw material (paper).

The document transportation mechanism must be capable of selecting one document from the input station and transporting it to the read station. Here it may be necessary to move the document under the reading head as part of the scanning process. Finally, the document has to be ejected and stacked in the correct sequence in the output station or stations.

The maximum capacity of the input and output stations should be considered, and the frequency of refilling determined when the machine is running constantly. A number of areas need to be checked:

1. Paper misfeed
2. Double pick-up
3. Accuracy of location
4. Jams
5. Serviceability for routine maintenance

When two documents are picked up together they should not pass through the unit as one. Detection devices should either indicate to the operator that the condition has arisen and await correction or there should be an automatic procedure for eliminating the problem. Ideally, documents should be read in the sequence presented and delivered in exactly the same sequence in the output station. Lengthy operator sorting procedures should be avoided and the possibility of the data or text being read in the wrong sequence should be minimized.

If the documents have been mishandled or the material does not meet the OCR manufacturer's minimum requirements, jams and malfunctioning of the transportation system will increase. These waste machine time and require the constant vigilance of an operator. Clearing such mishaps should be a quick, simple operation needing only minimum skill and special tool requirements.

Accuracy of location is important because the initiation of the reading cycle is often based on this location. Speed and accuracy do not go hand-in-hand, and one is traded off against the other. If accuracy in location is a problem, this manifests itself as machine down time and increased operator vigilance.

3. DOCUMENT CHARACTERISTICS

The paper size, weight, color, fluorescence, gloss, opacity, friction, curl and rigidity characteristics are all-important when considering handling and recognition standards.

The individual requirements of each machine should be established with the resultant effect on material costs. A small increase in the cost of paper standards can result in a large dollar increase per year for material purchases.

4. SCANNING TECHNIQUES

A. BASIC ELEMENTS. An OCR unit consists of a light source, a method of displacing a light beam over the text to be scanned, a method of translating the reflected light into an electrical signal, and a method of comparing the 'read' character image with stored 'master' characters to achieve identification.

The light is projected onto the text to be read and the reflected light is detected and converted into an electrical signal by a photo cell or transistor. The amount of light reflected will depend on whether the light was reflected from a dark area (the character) or a white area (the paper sheet), and will determine the strength of the electrical signal generated. The OCR equipment 'builds up' an electrical outline or picture of the character being scanned. When this process is completed, the scanned character is compared with electrical master characters stored in the OCR unit. When the nearest match or correlation is made, the character is identified and a digital code assigned to it. Once a character is scanned, recognized, and a digital code assigned, normal data manipulation can take place.

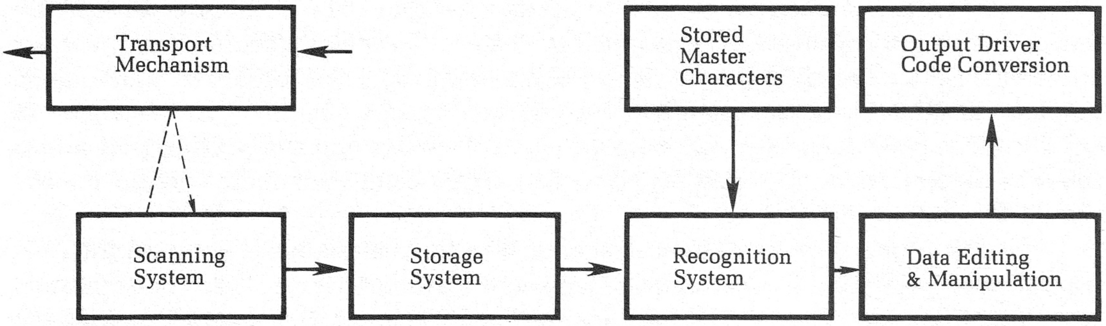


Figure 21. OCR Function Block Diagram

B. FLYING SPOT SCANNER. These units consist of a cathode ray tube (CRT), a lens system, and a photomultiplier. The CRT scans the document with the beam of light generated on the CRT phosphor coating. The reflected light from

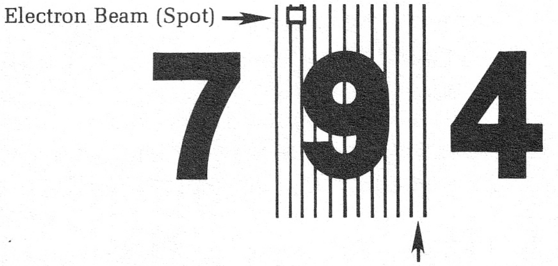


Figure 22. Flying Spot Scanner Technique

the document is directed to the photomultiplier which converts the light into an electrical signal proportional to its light strength. The advantage of a CRT is the speed at which the spot can be moved over the face of the CRT. Therefore, the system offers speed and flexibility to scan selected portions of the document.

CRT systems tend to be expensive and have defined limitations on their resolution due to the problem of overcoming inherent distortions.

C. PARALLEL PHOTOCELLS OR PHOTOTRANSISTORS. These have a scanning unit which consists of a vertical row of photocells. The character to be read is passed under the photocells which simultaneously sample a number of elements of the character and convert the reflected light into electrical signals. It is possible to have an increased number of photocells so a complete character can be scanned in one operation; this increases the speed and also the price. The method of scanning one character at a time uses a ‘Retina’. The approach allows high speeds to be achieved on scanning but does necessitate mechanical drive systems to move the reading head over the document or the document under the reading head. Variations or line skew, within limits, can be over-

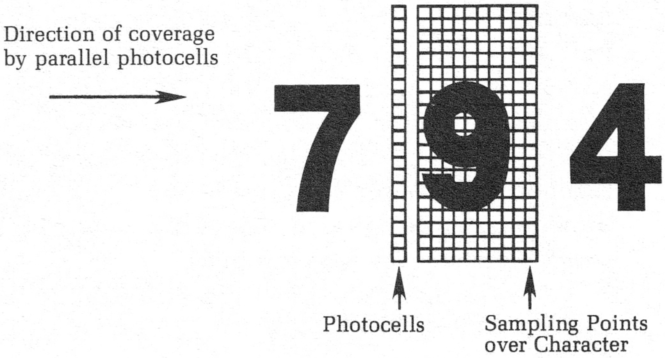


Figure 23. Parallel Photocells Scanning Technique

come by tracking or stepping the array or paper in the direction of the skew. The parallel photocell technique is relatively slow due to mechanical limitations.

Until recently, the disadvantages of this system have included high cost; with the introduction of phototransistors, prices have been reduced dramatically. The approach does limit flexibility for reading handprint.

D. LASER. This approach uses a laser as the light source. The laser produces an intense monochromatic beam of light with a very narrow diameter. The displacement of the beam over the document is achieved with a moving mirroı system. The advantages of the system include high resolution which helps in recognition of handprint.

Because of the use of mechanics and a mirror when displacing the light beam, the system can be slower than other scanners. Lasers are expensive sources of light.

E. VIDICON. With a Vidicon system, the light reflected from the document is transmitted onto a vidicon television camera tube where it energizes a cathode. The electron image on the cathode is scanned by an electron beam and the cathode image is converted into electrical signals. The main advantages of this technique are speed and the elimination of some of the mechanical devices for document or reader movement. The disadvantages are the temperamental nature of vidicon tubes.

5. RECOGNITION TECHNIQUES

A. MATRIX MATCHING. This technique requires a master character to be stored in the OCR memory for each different character to be recognized. This is normally accomplished using digital registers or resistor matrices representing each different character to be recognized. The electrical output of the scanning mechanism is stored and later compared to the stored master characters. Recognition is based on the relative comparison and probability of each match achieved. Distinctive character characteristics are categorized when scanned. The comparison is made with the characters stored in the category to provide faster recognition. These characteristics include shape, height, and width factors of the read character.

The approach offers speed, flexibility to change the character sets, and the ability to identify a large set of alphanumeric characters. The technique has been reduced to a fairly low price and is prevalent on most OCRs used in the printing and publishing industry. The disadvantages include the necessity of having a master character stored for each different character to be read. It is also difficult to recognize handprint with this system.

B. STROKE ANALYSIS. This technique analyzes each area of the character and

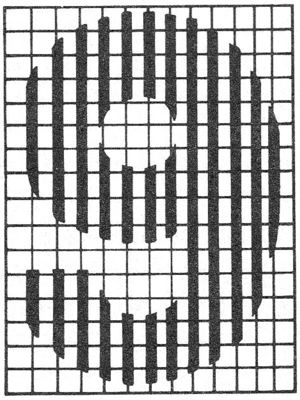


Figure 24. The Scanned Character Stored in Memory

breaks it down to the strokes or line formations. The results are compared with stored masters of each different character which can be read. The method is flexible to the extent that it can identify the full alphanumeric character set. However, it is slower than other methods and is not suited for handprint recognition.

C. FEATURE DETECTION. This method utilizes a combination of hardware and software. Each section of the character is analyzed and categorized by feature, either a line curve or angle. These major shape elements are processed through a decision tree until an acceptable correlation with a known outline is reached. This method is particularly suitable for multifont reading and is often capable of recognizing misregistered or degraded characters. The penalties incurred for this greater flexibility are slow speed and a high cost.

D. CURVE TRACING. This technique is the most flexible approach for recognizing slightly differing outlines of the same character representation. The scanning beam traces the outline of the character by movement of the scanner beam or by logical decisions of the recognition unit. Having traced the character, the recognition takes place based on features of the character, viz., character splits, line junctures or intersections, line directions, straightness of lines, and the line magnitudes.

The flexibility of the system makes it the most suitable technique for handprint recognition. It is, however, slow and the accuracy is sometimes low with low-quality input. Problems are sometimes encountered with broken lines.

6. HANDPRINT

Handprint recognition is the ability of the OCR device to recognize certain alphanumerics written by hand as opposed to characters keyed on a typewriter. The development of handprint recognition has, on the face of it, many advantages for the printing and publishing industry.

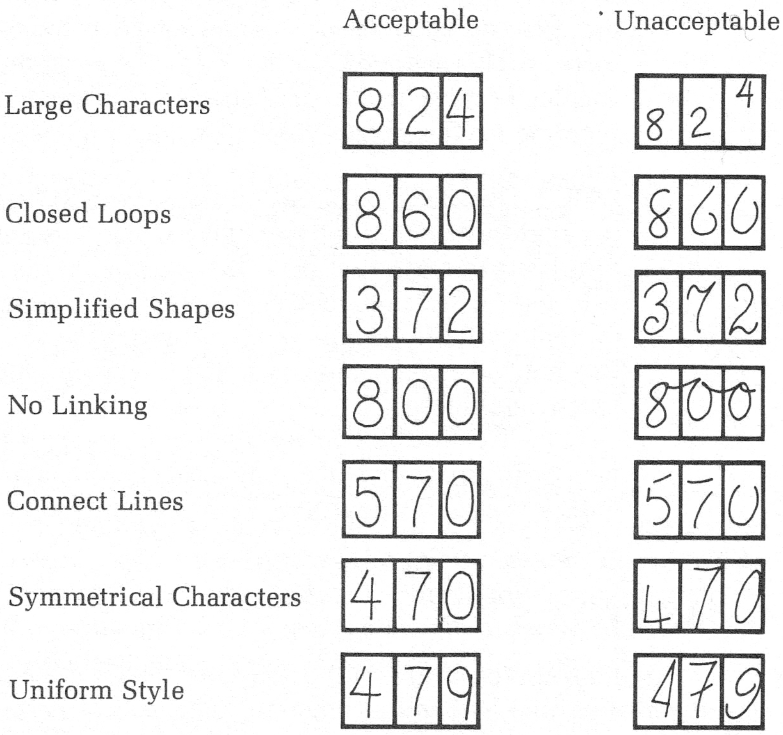
1. Commands or mark-up instructions can be added to the copy simply and quickly.
2. The hardcopy does not need to be returned to the typewriter to add instructions.

Most manufacturers of handprint recognizing machines have training and instruction manuals for OCR handprinting. The characters have to be drawn with many restrictions; to make the writing process easier, sheets are preprinted with boxes. The permissible character density is approximately five characters to the inch. Handwritten characters should fill the box, have closed loops, use simplified shapes, not have linked characters, should connect the lines of the character, and be as nearly symmetrical as possible. Different styles of characters are not allowed.

The systems currently available still present problems as follows:

1. The preparation of the handprint data has to be done extremely carefully to avoid having the OCR reject the material.
2. Extensive training is required to produce the skill for proper handprinting.
3. Even under ideal conditions, the reject rate is still high—between 3% and 15%.
4. The handprint instruction, if it is a typographic command, must be recognized without error. A small error of a single character would require an entire take to be reprocessed.

Figure 25. OCR Handprint Requirements


Acceptable
Unacceptable
Large Characters
824
824
Closed Loops
860
860
Simplified Shapes
372
372
No Linking
800
800
Connect Lines
570
570
Symmetrical Characters
470
470
Uniform Style
479
479

5. The recognizable character set is still generally limited to numerals and a very small number of alpha characters. The following is a typical example graphically showing the requirements for handprint produced for recognition on an OCR unit.

Although the development of handprint recognition has come a long way, it still has far to go before it is of material benefit to the printing and publishing industry. The ability to read a wide range of typewriter alphanumeric characters and an extended range of handprint designs with a high degree of accuracy is the prime industry requirement. Until this requirement is met, handprint reading will not pay off.

7. ERROR RATES

Error rates quoted for OCR units range from 1 in 10,000 to 1 in 25,000 characters read using ideal copy as input. However, the accuracy of the OCR unit is, to a large extent, determined by the quality of the input. If you put rubbish in, you will get rubbish out. Recognition errors are generally caused by:

1. Machine malfunctions
2. Ambiguous characters
3. Invalid data or setting up of the OCR unit
4. Poor-quality documents

Machine malfunctions are specific to the unit in use.

Ambiguous characters are characters which the OCR unit cannot identify based on the threshold value set. Such characters can be smudged, broken, or otherwise poorly formed. Handling of ambiguous characters varies. The OCR can insert its 'best guess' or it can stop and call the attention of the operator to the problem.

If the 'best guess' cannot be discovered for verification at a later stage in the process cycle, a high probability exists that the error will go undetected; this is obviously undesirable. A better procedure would be to have the OCR insert, prior to the best guess, a symbol that indicates that the following character has to be checked by an operator.

If the machine stops, the ambiguous character should be shown in context on a VDT or other suitable viewing device to allow the operator to decide what the ambiguous character should be.

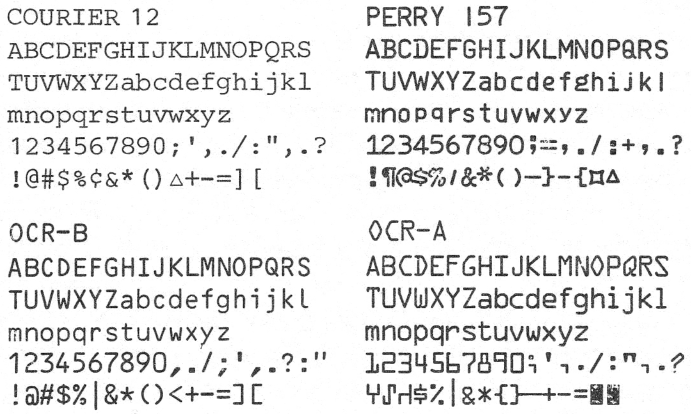
The error rate of even the most accurate OCR unit necessarily implies that checking of the text should take place after reading. The actual rate of OCR recognition errors, within limits, is not critical because all of the text has to be proofread in any case. A general procedure should be established which provides that all material read by an OCR unit be proofread for accuracy before further processing.

8. FONTS

A. OCR FONTS. The most commonly used fonts for the graphic arts application are:

1. Courier 12
2. Perry

3. OCR-A
4. OCR-B



COURIER 12
ABCDEFGHIJKLMNOPQRS
TUVWXYZabcdefghijkl
mnopqrstuvwxyz
1234567890;',./:",.?
!@#$%¢&*()△+-=][

PERRY 157
ABCDEFGHIJKLMNOPQRS
TUVWXYZabcdefghijkl
mnopqrstuvwxyz
1234567890;=,./:+,.?
!¶@$%/&*()—}-{¤∆

OCR-B
ABCDEFGHIJKLMNOPQRS
TUVWXYZabcdefghijkl
mnopqrstuvwxyz
1234567890,./;',.?:"
!@#$%|&*()<+-=][

OCR-A
ABCDEFGHIJKLMNOPQRS
TUVWXYZabcdefghijkl
mnopqrstuvwxyz
1234567890;',./:",.?
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Figure 26. Examples of Fonts Used for OCR

Courier 12 was selected by one manufacturer because it promotes both accurate recognition and aesthetic reading appeal for the operators and personnel who produce and read the text. The font, therefore, met two requirements — that of man and that of machine.

Perry was orginally designed for a West Coast newspaper and does not include traditional descenders. This feature allows more text to be contained on a page.

OCR-A was developed for OCR by The American National Standards Institute (ANSI). The design was primarily for general OCR machines and is not tailored to the specific needs of the printing and publishing industry.

OCR-B (1SO-B or ECMA-11) is more easily read by humans than OCR-A. Consequently it requires greater ability on the part of the OCR unit for proper recognition. OCR-B is principally used in Europe and consequently has several different layouts which include the special language features of accents and symbols.

The font design is based on uniform character widths. Often a small character design is used on a large escapement typewriter which provides large space between the characters; this makes recognition easier and minimizes the possibility of characters touching or overlapping. The horizontal spacing of a typewriter is the 'pitch'. A 12-pitch design normally allows 12 characters per inch or 1/12″ is the space allocated to each character. A 12-pitch character design can be used on a 10-pitch escapement typewriter to allow extra space on each side of the printed characters.

B. HANDPRINT FONTS. An ANSI standard is proposed and may be adopted in the near future. The fonts all contain alphanumeric information and a limited number of special symbols. This standard would not provide more than 96 characters, the same number obtained on a typewriter. As previously discussed, this is significantly less than the minimum requirement for typesetting.

9. EDITING

Although there is a term 'OCR editing', which implies a machine operation, it is a misnomer. The procedure is manual. The editing instructions must be inserted by the operator on the typewriter in the spaces between the lines on double-spaced OCR copy. The most common editing routine used in this typing-in of edit instructions is deletion of:

1. character
2. word
3. line

To achieve this, the copy typist, detecting an error during initial typing, does not back space and overstrike as would normally be done, but simply keys a special symbol once, twice, or three times. The OCR unit is programmed so that when it encounters this symbol it deletes from its memory the preceding character, word, or line depending on whether the delete symbol appears consecutively one, two, or three times respectively. This technique allows fast, clean correction of errors detected during initial keyboarding.

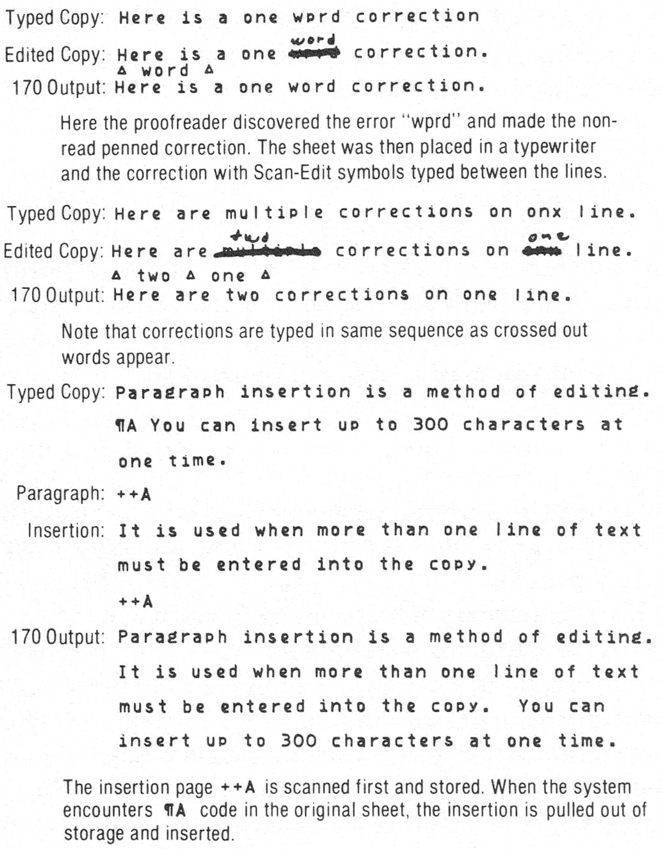
The same effect can be achieved on an already typed page by drawing a large pen line through the offending character, word, or line. Care has to be exercised to insure that the penned deletion line impinges only on the area to be deleted. The pen has to produce a broad, clear mark that the OCR unit will recognize. Since this is a careful drawing operation, it cannot be done as quickly as the conventional proofread marking.

The deletion of space or spaces is a more complex problem. One OCR system that employs a flexible method of scanning spaces can allow the insertion or deletion of space. Another system allows the unwanted space to be overstruck with an ignore character and it is thus disregarded.

The next level of editing is the deletion of incorrect, double (or more) spaced text, and the insertion of new text. The deletion is normally accomplished by striking through or typing over the text. The new text is keyed on the typewriter in close proximity to the line to be corrected (normally above, below, or at the side of).

When read by the OCR unit, the deletion (pen line or overstruck characters) in the line, will be omitted. The OCR unit will 'look for' the new text and, having found it, insert it in its correct location. If more than one correction is made in a line, the corrections must be 'delimited' by a slash or appropriate character. In a line with several deletions, of which one or more does not have any new text to be inserted, the delimiters are still used but no new text is keyed. The proper use of a sequence of delimiters should allow the system to keep track of and always insert the proper text at the proper location; this is not too easy to do in practice.

An enlargement of this approach would be to type corrections on separate sheets with the full page, line, and word position information. The OCR could then merge the corrections with the original text. The procedure is reversed from the normal approach in



Typed Copy: Here is a one wprd correction

word
Edited Copy: Here is a one correction.
△ word △
170 Output: Here is a one word correction.

Here the proofreader discovered the error "wprd" and made the non-read penned correction. The sheet was then placed in a typewriter and the correction with Scan-Edit symbols typed between the lines.

Typed Copy: Here are multiple corrections on onx line.

two one
Edited Copy: Here are corrections on line.
△ two △ one △
170 Output: Here are two corrections on one line.

Note that corrections are typed in same sequence as crossed out words appear.

Typed Copy: Paragraph insertion is a method of editing.
¶A You can insert up to 300 characters at
one time.

Paragraph: ++A

Insertion: It is used when more than one line of text
must be entered into the copy.
++A

170 Output: Paragraph insertion is a method of editing.
It is used when more than one line of text
must be entered into the copy. You can
insert up to 300 characters at one time.

The insertion page ++A is scanned first and stored. When the system encounters ¶A code in the original sheet, the insertion is pulled out of storage and inserted.

Figure 27. Typical Examples of Editing for OCR

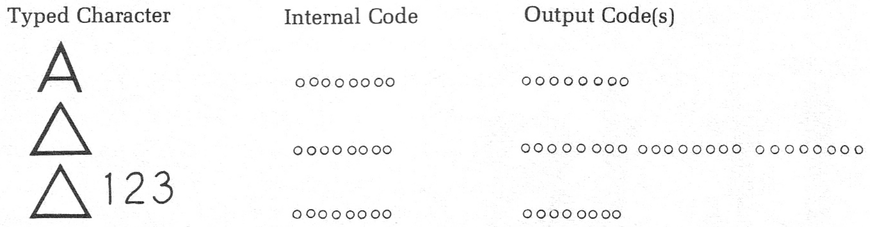
that after the corrections are typed, they are read and stored in the OCR unit, then the original text must be re-read. When locations of the corrections (page, line, word details) coincide with locations in the original text, the correction text is inserted in the text held in the memory of the OCR.

Other variations exist but they are based primarily on the foregoing techniques. With the exception of the deletion of characters, words, and lines at the typewriter during the initial keyboarding, the OCR correction methods are cumbersome and very time consuming. Care has to be taken when re-entering a page into a typewriter to type correction information to ensure that the original and correction typed matter align. The more times the typed sheet is handled manually, the greater the chance of degrading the sheet. If corrections are complex or deleting marks are numerous, it is virtually impossible to correct the original typed matter and the material has to be retyped.

10. CODE CONVERSION

A most useful and significant feature of some OCR units is their ability to convert text into the coding structure required by the typesetting system.

Figure 28. Diagram of OCR Code Conversion



Normally, the OCR unit, after recognizing a character, assigns it a character code. This code is in the language used internally by the OCR unit. When text is ready for output or transmission, it is processed through an output routine. At this stage the internal OCR machine code is translated to the output code. This output module or routine can be written in a way that greatly simplifies the user's task of changing and modifying the output codes.

The operator should not only be able to change a code on a one-to-one basis, but also to assign whole coding strings to a particular symbol. For example, one character keyed, read, and allocated one internal OCR machine code can, on output, generate a whole string of codes. This makes it possible to minimize the keyboarding necessary on the typewriter when repetitive code combinations on output are required. Keep in mind that the main restriction of the OCR/Typewriter approach is the limited character set of the typewriter. To increase the coding structure that can be generated, characters or symbols are nominated as shift codes. These shift characters instruct the OCR to interpret the characters that follow as something other than normal. The OCR unit can recognize these shift characters and small strings of output codes.

Methods for using shift codes are easily learned by an operator possessing normal skills without special programming training. This approach is normally adopted to overcome the necessity of modifying the main software package in the typesetting system. This typesetter program modification is usually complex, costly, and requires the skills of a programmer.

The improvements in OCR techniques and the resultant reduction in work production costs that have occurred in the last three years have been considerable and are a tribute to the engineers who have worked on OCR systems. OCR technology is complex and the production of a high performance, low-cost, reliable unit has been somewhat difficult to achieve; this has been done to a great degree. The basic evaluation and consideration of the system is not 'Does it work?' but 'Can it be used profitably?' If the OCR unit is to be used as an input device in much the same way as a paper tape reader, then the answer is most probably 'yes' to this question.

An extension of OCR to include the editing or 'systems concept' is probably not desirable at this stage of technological development; currently there is little to indicate that this will change dramatically over the coming years.

11. OPTICAL BAR RECOGNITION (OBR)

The fundamental difference between OCR and OBR is that OCR reads or recognizes the normal typed characters. The same characters which are recognized and read by

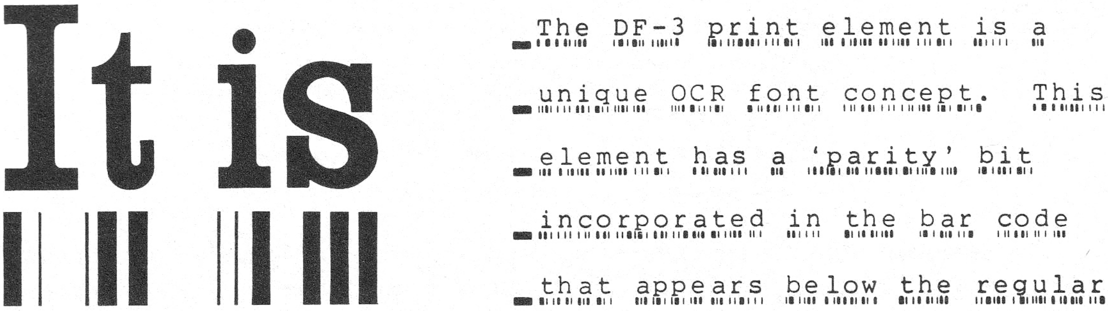


Figure 29. Example of an OBR Font

The DF-3 print element is a
unique OCR font concept. This
element has a 'parity' bit
incorporated in the bar code
that appears below the regular

the human 'reader' are used as the input to the OCR unit, which in turn reads and recognizes the characters. In OBR, a special typing element is used which prints the character and the code assigned to the character. The code is printed in optical form and consists of a combination of vertical lines which, when read by the OBR, will be interpreted as a code.In the preparation and keying of text, two distinct pieces of information are printed: the character for human recognition and the bar code for the machine recognition. The OBR unit does not concern itself with the characters at all. It simply reads the bar codes. The system can be thought of as bilingual, enabling human and machine reading of text, each having its own method or system of display.

The concept represents a more recent approach to optical page reading. This became available to the printing and publishing industry in 1970. The 'separation' of the human and machine readable data significantly simplifies the machine reading task. The ability to machine-read bar codes is not so complex or technically challenging as machine reading typewriter characters; consequently, OBR units are significantly cheaper than OCR units. For the printing and publishing industry, OBR can be purchased for less than $15,000 compared with $30,000-$40,000 for OCR. In addition to its low cost, OBR has another significant advantage. Since the OBR unit only reads and recognizes the bar coding, it does not matter what character or design of character is placed above for human reference. The accuracy is based on the system's ability to read the bar codes.

The principal disadvantages of OBR are the presence of the visible bar codes which can be distracting when a human has to read the text, the lower packing density of information due to the additional space required for the bar code, and the stringent procedures which have to be adopted to ensure the typed sheet's geometry is correct and acceptable for reading.

The typing elements are produced by IBM. The original design, DF-2, has large bar codes and this restricts the size of the normal characters. To overcome this problem a later design using smaller bar codes and larger characters (DF-3) was produced. In each case, the bar structure is based on 8(DF-2) or 9(DF-3) vertical bar positions, and three distinct weights or thicknesses of the discrete binary are translated into a reference coding structure by the reader. The later design, DF-3, incorporates a parity bit which is stated to improve the accuracy of recognition. The typing of text has the same restrictions as exist for OCR. The typewriter should produce an even, clean print of each character; paper should meet the physical requirements of the OBR unit, and the text should be positioned bearing in mind margin requirements, etc. Over and above the accepted restrictions of OCR, OBR is particularly sensitive to skewed or misplaced lines. Usually the start of each line has to be visibly indicated with a special symbol. Because of the technique of recognition, OBR is less flexible in interpreting 'spaces'. Because a space does not have a code and appears blank, it needs to be delimited by text, or the recognition logic becomes confused. Therefore, indents, tabular work, etc., are more difficult to produce.

Editing can be achieved on the typewriter to delete characters, words, or lines using a deletion or rub-out symbol. When the OBR encounters the symbol it will automatically delete the appropriate character, word, or line.

The OBR units can be used off-line and will produce paper tape or magnetic tape. In addition, OBR can be placed on-line to a minicomputer usually via the RS232 interface, using ASCII or TTS coding structure.

D. VIDEO DISPLAY TERMINAL (VDT)

1. INTRODUCTION

Although VDTs are fairly expensive at the present time, they are still the ideal devices for input editing and control of copy.

The Video Display Terminal (VDT) is a critical part of an electronic system — it is where the rubber meets the road. A good computer system with VDTs which has not been designed for use in printing and publishing, will never impart optimum performance to the system. The VDTs will place demands on the central processor that will degrade system performance. The ideal electronic system is one that utilizes intelligent terminals that can think on their own and give instant results to a variety of keyboard commands. The name of the composition game is to keep keystrokes to a minimum when inputting material, correcting and editing, and typographically preparing material to be set on the phototypesetter. Rework and pasteup should be kept to a minimum. There is a great deal of interest on the part of the newspaper industry in doing full-page composition with an electronic system. These efforts, no matter how big and expensive the main computer, will have serious shortcomings unless they have a full-page VDT terminal which can interact in real time with an operator.

2. THE CASE FOR INTELLIGENT VDTs

The printing and publishing industry VDT must be designed to minimize keystrokes and produce work that requires a minimum amount of rework. An intelligent terminal designed for the EDP (Electronic Data Processing) Industry would require over 500 keystrokes to remove a 500 character paragraph. Contrast this with the 3 keystrokes to remove the same 500-character paragraph using a printing and publishing VDT. This comparison will give you a feel for the distinctive characteristics the printing and publishing industry impose on the VDT. In addition, the intelligent printing and publishing VDT could probably close up the white space and leave the copy 'clean', whereas the normal

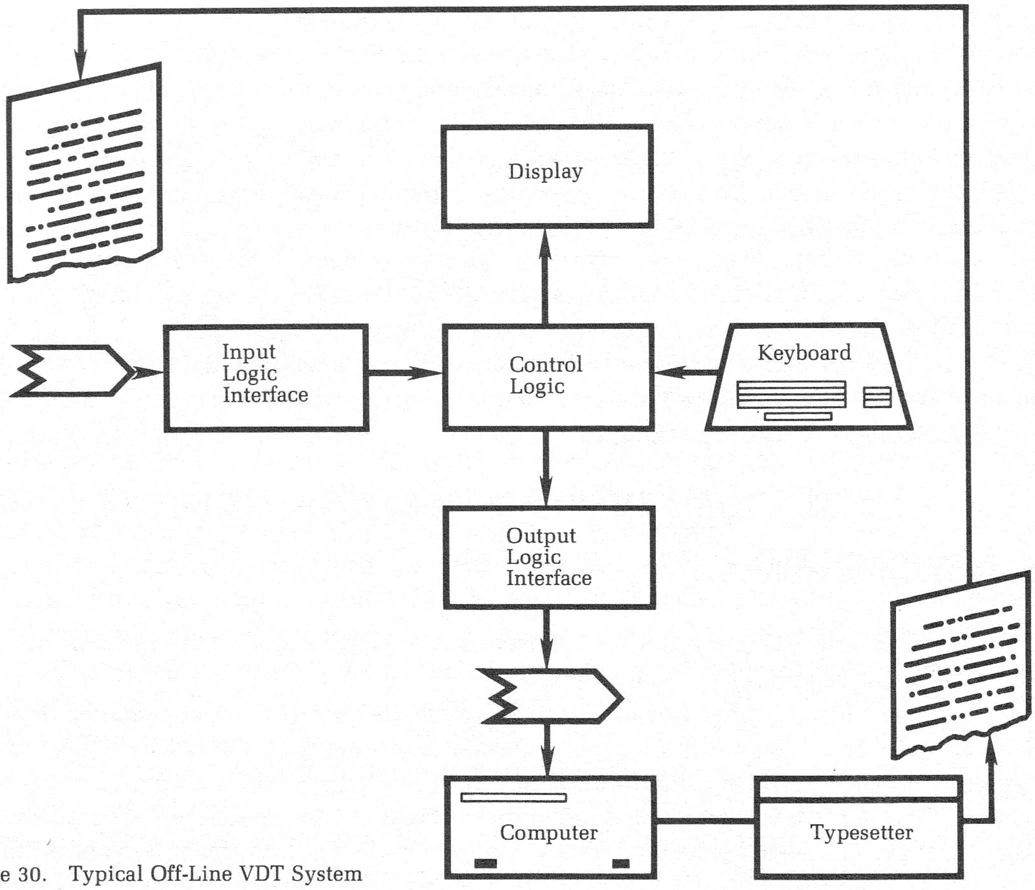


Figure 30. Typical Off-Line VDT System

EDP terminal would require a great deal of further clean up. The intelligent VDT could perform this operation in a way local to itself without placing demands on a central computer. A clever main computer design could 'fake' this performance by letting the main computer perform these functions. This faking could impose some serious loading on the CPU. If the VDT screen material was stored in the core of the central computer, the loading would be tolerable for a small number of VDTs. If the VDT screen material was stored in disk storage, the loading could be intolerable. It could take the computer the execute time of over 500 instructions and the equivalent I/O time to transfer the screen material to the VDT if the screen material file is in core. If the screen material file is in disk, it could take a considerable number of rotations of the disk to find the file and the instruction execute time of 500 instructions. If the entire find and execute operations are performed without interruption, it normally would not take more than a few seconds to respond to one VDT, but would deny other users (other VDTs) access to the system during that time. A VDT keyboard operator experiences little rhythm interruption if the total delay experienced with a key depression is a maximum of 200 milliseconds (1 millisecond = .001 seconds). Delays longer than this interrupt the rhythm and thrust the operator into an inefficient mode. It does not take a large number of unintelligent terminals, with almost any system, to rapidly reach this delay level. Some unintelligent VDT computer systems have delays which run many tens of seconds for some simple operations, and minutes (worst case) for complex functions. Another distinct advantage of the use of intelligent terminals is that one set of VDT hardware can be used, with automatic program call up, to perform a variety of functions such as classified ads, editorial, composition, etc. This hardware commonality can significantly lower maintenance costs which are usually significant and often overlooked when considering an electronic system.

We have given a previous example of a paragraph remove, now let us consider a one-character remove in a take of 8,000 characters. After this example, one will realize that there is a large family of different conditions which can affect system performance. The bounds on this family are rather easy to determine, but within the family a whole host of dynamic conditions can occur and each system will react differently.

When this remove is performed on an unintelligent terminal a great burden can be thrown on the central computer (processor). It may take the processor 8000 x 8000 instructions to complete the operation. If the execute time for an instruction is 1 micro second (.000001 second), it might take 64 seconds to complete the operation. Not all systems will take this long since many of them have clever short cuts. Nevertheless, unintelligent terminal systems will not perform nearly as fast as the intelligent terminal systems.

Because of the delays caused mainly by roll up, removal and insetion of large texts, delays experienced with a large number of VDTs can be beyond acceptable limits.

Now let us turn our attention to the number of keystrokes required to get the job done. Keep in mind that a VDT is not much better than an electric typewriter with high speed accurate typists (if there are any such to be found) for raw input. For editing and correcting, the VDT offers significant advantages over any other known method. OCR (Optical Character Recognition) approaches are particularly cumbersome when editing and corrections are involved. And after all, the purpose, particularly in newspapers, is to allow the human being to modify, at will, the material to be printed, otherwise why not just set the newswire input in type?

3. GENERAL CHARACTERISTICS

Now let us examine the general characteristics of a VDT to determine what the important features are and why they are important. The features are listed in the following table.

Table Three. VDT Functions and Characterstics

- Screen Size
- Phosphor
- Refresh Rate
- Scan Method
- Character Generation
- Page Display Format
- VDT Memory and Organization
- Character Repertoire
- Keyboard
    - Alphanumeric Typewriter
        - N-key Roll over
    - Repeat key
        - Memory Buffer
        - Code Translation

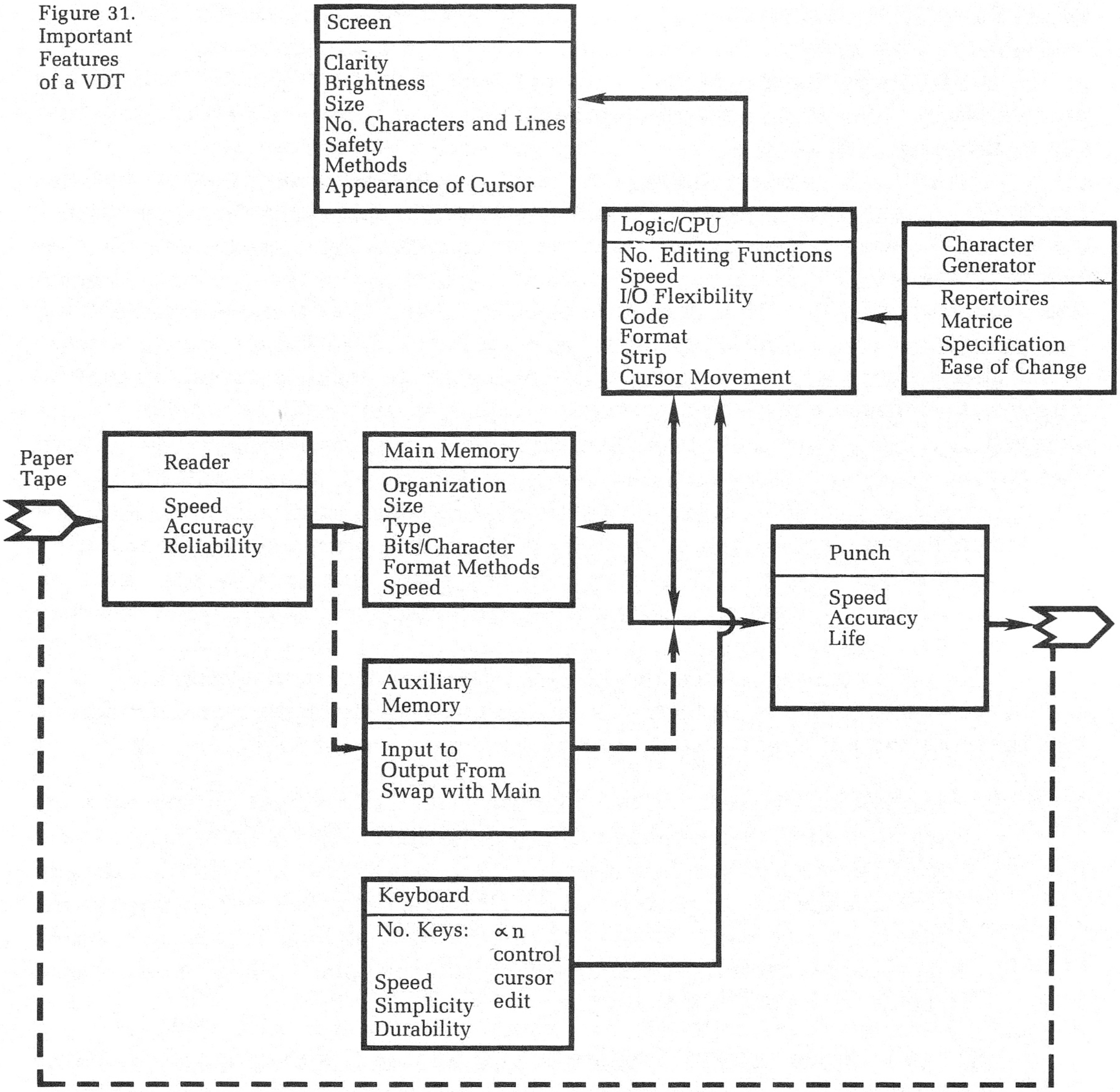
- Editing
  - Cursor Control
    - Cursor Up
    - Cursor Down
    - Cursor Right
    - Cursor Left
    - Cursor Home
    - Cursor to End of Text
    - Cursor to Next Paragraph
    - Cursor to Beginning of Text
    - Set Skip
    - Skip
    - Back Skip
    - Define Search
    - Search Forward
    - Search Backward
    - Area Movement
    - Roll Up
    - Roll Down
- Character Editing
  - Overtype Character
  - Insert Character
  - Delete Character
- Text Editing
  - Delete:
    - Word
    - Sentence
    - Paragraph
    - Line
  - Moving Functions:
    - Move Sentence
    - Move Paragraph
    - Move Block
- Clearing Functions
- Editing Delimiters
- Terminal Status Indicators
- Format
- Tabular Handling

4. SCREEN CONSIDERATIONS

The screen size is important primarily to insure legibility and clarity of the visual presentation. In general, large characters are more legible than small ones. Character movement and swimming around is undesirable since this can cause operator fatigue in the form of headaches, irritability, and low efficiency. The characters on a VDT are not good enough to film since they are nonlinear; that is to say, the characters on the left side of the screen have different widths than those on the right side of the screen. Since the surface of the display tube is not flat, these nonlinearities are difficult to detect with the eye. The horizontal lines on the screen are not horizontal or parallel over the entire display. CRT phototypesetters usually use a flat-faced display tube and a great deal of correction circuitry which has been developed to straighten out or correct these nonlinear difficulties on the face of the display tube. This correction art cannot economically be applied to a VDT used for input, editing, and typography.

The eye is the best judge of the appearance on the VDT display screen as long as the number of characters in a line is adequate for the measure and the number of lines sufficient for a sizeable take of text. A careful observation will detect swimming, nonlinearities, flicker, and misshapen characters that may cause operator grief. Do not try to be too critical since experience has shown that operators can live with a lot of imperfections in this area. As a guide, line lengths of less than 80 characters are not up to the state of the art. A number of lines less than 20 is below the state of the art at present. Most displays utilize a black and white television monitor which means that it is part of a standard TV set. The monitor is usually purchased from a TV monitor producer and not produced by the display manufacturer. Since the VDT manufacturer cannot afford to build his own TV monitor, he is limited

Figure 31.
Important
Features
of a VDT


Screen
Clarity
Brightness
Size
No. Characters and Lines
Safety
Methods
Appearance of Cursor
Logic/CPU
No. Editing Functions
Speed
I/O Flexibility
Code
Format
Strip
Cursor Movement
Character Generator
Repertoires
Matrice
Specification
Ease of Change
Paper Tape
Reader
Speed
Accuracy
Reliability
Main Memory
Organization
Size
Type
Bits/Character
Format Methods
Speed
Punch
Speed
Accuracy
Life
Auxiliary Memory
Input to
Output From
Swap with Main
Keyboard
No. Keys:
∝n
control
cursor
edit
Speed
Simplicity
Durability

by the state of the art in what he can economically afford to buy. There is one well known VDT system that is an exception to this rule of thumb — it can display different size characters. Its high price illustrates the point that is made here.

A lot of scientific measurements can be made to determine contrast ratios, light output in foot lamberts, and a host of other physical characteristics of the display, but in the final analysis it is the operator's eye that is the final judge; not all operators will have the same opinion of a given VDT screen presentation.

The phosphor is the coating on the inside of the TV tube that produces the visible light for the eye to see. There are a great number of different phosphors utilized in the display art; however, since the black and white TV monitor is the common denominator, the only phosphors that are important are the ones that can be used properly on a TV monitor.

Different substances are used to make a phosphor impart the color that the eye sees. Basically, there are two primary phosphors used for TV; these are a white phosphor and a blue-green phosphor.

According to a host of studies, the blue-green phosphor is supposed to cause less eye fatigue than the white phosphor. Certain blue-green phosphors have 'long' persistence in that when a change is made on the screen, the old characters fade away and the new ones emerge. The white phosphor gives a more instantaneous character change. The blue-green phosphors reportedly give pink after-vision (an effect that if the screen is viewed for long periods of time, white will no longer appear as white but as pink). The eye always recovers if pink after-vision is encountered. The white phosphor has some advantages in contrast ratio, viz., the difference between the turned-on characters and the off background. When a reverse field is used — the background turned on and the characters turned off, to denote a bold face for example — the white phosphor may be preferred. More people are used to viewing a black-and-white TV screen than are used to viewing a black and blue-green TV. If VDT images are in colors (such as orange) other than the two previously mentioned, it is a good indication that a standard TV monitor is not being used. Any good TV repair man can fix a black-and-white TV, but may be completely at a loss when special circuitry is used to make the picture.

The main industry thrust behind the solid state circuit technology supports the TV approach. Any other display method must be supported solely by the manufacturer that uses the other method which is costly and may not have long term life.

A. IMPLOSION PANEL. The implosion panel is an almost bulletproof glass about ½″ thick that is bonded to the face of the TV tube bulb. Its purpose is to keep the electron gun from harming the viewer in the rare event that the gun breaks. If the gun should break, part of it would be hurtled forward through the face of the tube with considerable force. Most, if not all, television sets sold in America have this implosion panel. If the manufacturer wants to cut corners, this is not a good one to cut.

B. POLARIZING SCREEN. This is not a wire type screen but a sheet of plastic that is polarized and has varying degrees of transmission. Transmission value generally varies from 70% to as low as 40%. The purpose of the screen is to eliminate unwanted reflections from the VDT tube face. VDTs without this type of screen are often like mirrors and the operator can see himself. This mirror effect is objectionable to the operator and causes fatigue. The lower the transmission, the better the contrast ratio and the less reflection is obtained from the VDT tube face; however, the displayed characters defocus. A good compromise is about a 50% transmission value. The polarizing screen is generally soft plastic and easily scratched.

C. OPERATOR CONTROLS. There are basically only three controls that the VDT operator should be allowed to adjust; these are focus, intensity and astigmatism. Other controls could have a confusing effect. All of these controls should have limits so that, for example, the intensity control should not allow the display to completely disappear. The focus control adjusts the sharpness and fuzziness of the display. Different operators prefer slightly different settings; the intensity control is strictly an operator preference adjustment. The astigmatism, if one is provided, adjusts the overall focus of the display so that a good average is obtained; so that some characters are in good focus and others are in average focus.

5. REFRESH METHOD

A. REFRESH RATE. The refresh rate is the number of times in one second that the entire display on the VDT screen is rewritten. The display must be rewritten a number of times in one second to make the human eye think the display is constant. The ideal refresh rates are 60 times a second for American use and 50 times a second for International use. These refresh rates are coincident to the hertz (cycle) per second of the power distribution. Power distribution noise finds its way into the VDT through a combination of magnetic and electrostatic effects. The effect of the noise can be effectively cancelled out if the refresh rate is the same as the power distribution cycle (hertz) per second. The noise that is picked up when other refresh rates are used must be 'filtered' out. The filtering is never perfect and can add to the cost. Noise results in movement, swimming, and raggedness of the characters on the VDT screen presentation.

B. SCAN METHOD. The scan method is basically how the characters are 'painted' on the VDT screen. The eye is fooled into thinking the image is constant when in actuality it is turning off and on. A TV scan is the most common example. The electron beam moves in one horizontal line left to right across the VDT screen, retraces/returns (off the screen) and scans again in a horizontal line displaced down from the 1st line. This is analogous to a standard typewriter with the exception that only part of the typing is done in each horizontal left-to-right traverse. It may take nine or more traverses to complete a line of typewritten material. This is a scan approach which began in the 40's when TV was developed, and is by far the most economical. There are a large number of integrated circuits made to create the displayed characters, generate timing and other items for this scanning method. Other scan methods have been developed but they are supported only by the particular manufacturer and not by the electronics community as a whole. With the use of a screen memory, which contains every allowable point (called dot) which could be illuminated (displayed) on the TV display screen, straight lines and line graphics could be generated and displayed along with signs and alphanumeric characters.

6. CHARACTER GENERATION

The characters or displayed signs on the VDT display screen are generated by dot arrays or strokes. The dot arrays are used on TV raster scans and the strokes on other types of scans. The number of dots used to generate a displayed sign determines to a large degree the display quality. Seven horizontal dot positions per line with eleven different vertical lines (7 × 11 array) is the minimum number of dots to satisfactorily make upper and lower case alphanumeric and required display signs. Occasionally a few tricks are used to help shape the signs. These tricks include offsetting the even scans by one-half of one dot position. Arrays of 5 × 7 (5 horizontal × 7 vertical) no matter how good or how many tricks are used, cannot generate appropriate signs for typesetting material.

7. PAGE DISPLAY FORMAT

Page display format refers to the number of displayable signs in a line of text and the number of lines that can be shown on the VDT screen.

A great deal of discussion has gone on in the trade about dual format (split screen) such as a split by right and left hand portions on the VDT screen. These things can be done with their associated price and complexity. In general, most VDT screens are not split but are one single format. Since 80 characters in one line is the present state of the art for TV scan displays, splitting it into two groups of 40 each would not allow a large measure to be displayed conveniently. Splitting the screen usually requires more memory to be associated with the VDT terminal and the necessary memory control logic circuitry.

VDT display screens suffer from their inability to put a sufficiently large number of signs on one line. Consequently, before the measure is reached the line overflows. This is called line overflow. Somehow the VDT should indicate, by displaying a special sign and indenting, that an overflow has occurred and should proceed to the next display line when the overflow line is finished.

The ability to handle a format on the VDT is very important since a great deal of material, such as a classified ad header, can be pre-organized. The pre-organized material is normally called a format. A good VDT should be able to display formats which have been constructed by operator entry on the VDT keyboard.

A format should act as a 'pasted on' portion of the screen in that it should not move or be altered as material is keyed in on the keyboard. An intelligent VDT can handle this format problem far easier than an unintelligent VDT supported by a very large computer system. Entry editing and clearing of signs from the VDT screen should not erase or alter the format.

8. MEMORY AND ORGANIZATION

The VDT must have memory to support the display screen. This memory cannot, generally, have other functions. The memory can be organized in the same manner as the display screen or can be organized in efficient mode. Efficient mode means that the memory is serially strung regardless of the screen display. For example, if there are 400 signs (characters) displayed, 400 memory positions are utilized regardless of how many lines on the screen the 400 signs occupy. This is by far the most efficient organization for straight text. A display screen organization basically means that for every position on the screen there is a corresponding location in memory. In this organization, 400 signs could occupy

800 memory locations if the signs were displayed 40 signs (characters) on a line and the allowable number of characters (signs) on a line was 80. A screen organized memory is the most efficient for tabular materiai. Ideally, a display should have both organizational modes, efficient for text and screen for tabular. Most VDT memories are volatile, because the contents are lost if the power is interrupted.

9. CHARACTER REPERTOIRE

In every presently available VDT there is a fixed number of signs (alphanumerics) that can be displayed on the VDT screen. Not only is the number fixed but the repertoire is unchangeable for the most part. Some VDT sign repertoire are partly defined by the manufacturer and partly defined by the customer; once defined they cannot be conveniently changed. This is normally because of the way the signs are generated by a ROM (read only memory = integrated circuit chips). The ROM ingests the character identity code and outputs the video dot patterns which produce the visual sign images on the VDT display screen. Since the cost of memory is being reduced by great strides, the video dot pattern could be stored in regular type memory that can be written, read, and rewritten. With such a storage scheme for the video dot patterns, the user could define characters to suit himself and use software routines to call in different sign repertories for different faces and jobs.

If the number of displayable signs is fixed on the VDT, then the larger the number, the more possibilities there are for representing different faces, pi mats, etc., with single characters rather then having two keystrokes and corresponding display sign to represent these required items. With two keystroke representations, the first is usually a shift sign which indicates that the following sign has a meaning different from its normal meaning. For example; ▲ could be the sign for shift, which means change the meaning of the next character, Y, from its normal meaning to, say for example, pi mat character #25 which could be a TV bullet or some such thing.This is called a shift code method. This method must be used when OCRs are being used as input devices since the typewriters used to produce the copy can only have a limited number of signs (98 is the usual number). This shift code method makes the understanding of the text complicated since there are usually a large number of shift codes. A shift code would have to be used to even represent a 'normal' 120 character font. Ninety-seven codes could have direct representation (allowing one for the shift code) and the remaining 23 codes would have to be accessed by one of the 97 codes preceded by a shift code. For complex work involving different sizes and typefaces, the coding structure can become very complicated and inefficient.

A good method to graphically understand this is to construct a table with all the alphanumeric signs that will be used for all the different type faces and styles that will be required, and equate them to the VDT display signs.

10. KEYBOARD

The keyboard is an important item of concern on the VDT. In general, the keyboard should have a sufficient number of keys to directly address all the display signs without more than two shifts; a shift in the same sense as a normal typewriter, i.e., shift small 'a' gives capital 'A'. The keyboard should have a sufficient number of keys to provide all cursor and edit controls without more than two shift levels. With more than two shift levels, the engraving on the keytops, which tells what the signs are, generally becomes unreadable and difficult to use. A good rough estimate of the ease of operation of VDT terminals can be made by merely counting the number of keys on the keyboard. The higher the number, the easier it will be to use. On the other hand, the keyboard should not be too large or the operator will require 'flying fingers' and special training.

Perhaps the next most important item on the keyboard is the feel created when typing is accomplished. This feel is a result of many things: the shape of the keytops, the amount of force required to depress the key on each row of keys, the distance each row of keys has to move to accomplish entry. On a Selectric typewriter, the tops of the keys are dished differently for each row; each row of keys requires a different force and different travel distances to accomplish entry. No VDT in the industry has the same feel as a Selectric typewriter; all of them are a compromise. Some are good compromises and others are less than good. The best way to test the feel of a keyboard is to have high-speed typists operate the keyboard and determine if it has the proper feel. If the proper feel is not there, analyze the situation and try to determine why. A hunt-and-peck, one-finger typist can utilize almost any keyboard without a performance penalty. This feel aspect is a hotly discussed subject, yet there are a lot of keyboards with distinctly different feels that are in use in the industry.

A. ROLL OVER AND DOUBLE STRIKE PROTECTION. These are critical issues with high-speed typists. A keyboard should ideally give two display signs if two keys are struck simultaneously; most keyboards give only one. Some keyboards give some other sign rather than one of the two that were struck; some are not consistent. Others present the signs in the order in which the fingers were picked up in what is normally called roll over. Some keyboards can accommodate a simultaneous depression of several keys and present the signs on the VDT screen in the order in which the keys were picked up (released). A good test to see if the keyboard can 'roll over' is to rub your finger across a row of keys similar to the way you might on a piano, and see if all the signs appear on the screen. Some keyboards have a maximum entry speed which is too low for high-speed typing of combinations of letters such as t — h — e. An entry speed of 15 characters per second is usually just fast enough to keep up with high-speed letter combinations.

B. AUTOMATIC REPEAT. Automatic repeat is a feature which means that if a key is held down after a pause, a multiple number of signs will be entered.

The automatic repeat feature, if the delay is too short, will create problems for lazy fingers typing. If the delay is too long, the typist can enter the multiples faster than waiting for the delay to end. On the alpha and numeric parts of the keyboard it would perhaps be advantageous not to have the auto repeat feature and have it on the cursor controls. The following keys should have the auto repeat feature: the space bar, roll up, roll down, delete character, cursor up, cursor down, cursor right, cursor left, cursor next paragraph, cursor next face, cursor next point size, cursor skip (to settable character), cursor search (for pre-loaded sequence). The following type functions perhaps should not have an auto repeat feature: delete paragraph, delete sentence, move block, move sentence, and move paragraph.

Rather than auto repeat, a key could be used to cause repeat entry; such a key is desirable. If it is held down, a second key depression will go into repeat mode. Only certain editing functions should not generally be allowed to be auto-repeated: move block, sentence move, etc.

A very important aspect of the keyboard is its mechanical ruggedness; it will really take a pounding in any printing and publishing environment. If the keyboard and keytops cannot withstand a gentle blow with a small rubber mallet, they probably won't hold up. The manufacturer should provide shock and vibration test data for the circuit element that is used to convert the keystroke to an electrical signal. The failure of one key destroys the effectiveness of the entire keyboard.

The keytops can normally have more than one color and can be coded in different ways. The different signs obtained by the key depressions can be color coded for the different shifts associated with that key.

11. EDITING

A. CURSOR CONTROL. In order to edit on a VDT, the location for the desired editing must be obtained by moving a cursor to that location. This action is performed by the cursor controls. The cursor is the highlighted spot that can be positioned anywhere on the screen by appropriate action, and indicates where the next sign entry will take place. The cursor should be easily distinguished from the rest of the screen, particularly when the VDT screen is full of text. Some early electronic data processing VDTs had destructive cursors in that they wiped the screen clean in the path over which they were moved. All cursors must be non-destructive. A blinking cursor is a normal method. Cursors that merely underline are generally hard to find (locate) and are easy to lose. A preferred cursor, is a large rectangular box which completely encloses the sign it is highlighting. Methods of having the highlighted sign displayed alternately (blinking) with the cursor are generally not preferred.

The cursor can be used to create a flash or some other very noticeable effect if an illegal entry is attempted. An example of this would be an attempt to enter a twelve digit phone number (including area code) in a classified ad taking format.

The following are cursor moving functions:

Cursor Up: Moves the cursor up one line; action should stop at the top line of the screen. Key should automatically repeat after about 250 ms delay, at a rate of about 5 steps per second.

Cursor Down: Moves the cursor down one line; action should stop at the bottom line of the screen. Key should automatically repeat as in cursor up.

Cursor Left: Moves the cursor one position left along a line; action should stop at the left margin. Key should automatically repeat after about a 250 ms delay (.25 seconds at a rate of about 5 steps per second).

Cursor Right: Depression of this key moves the cursor one position right along a line; action should stop at the right margin. Key should automatically repeat after about a 250 ms (.25 seconds) delay at a rate of about 5 steps per second. It is interesting to note that if an efficient memory is used to support the VDT screen, cases may occur when the cursor might go into areas where entry cannot occur or might even go off the screen (cursor disappears). The logic in the VDT should be clever enough to avoid these cases since they can be quite troublesome.

Roll Up: Since most VDT memories should have larger capacity than the screen size can accommodate, it is desirable to be able to gradually roll the text up as the VDT screen is filled. Paging is not as desirable since things can occur at the page boundaries that almost destroy the total value of the VDT as an editing tool. Paging (as on a sheet of paper) means to turn to the next 'sheet of paper'. Hyphenated words, widows, incomplete words, incomplete sentences, etc., can all be created if the information can only be paged on the VDT screen. Roll up should only occur if there is material to be viewed and should stop at the end of the material in order not to accidentally create a blank screen. The roll up key should have an auto-repeat capability.

Roll Down: This key should gradually roll the text down. It should not be allowed to roll all the material off the screen creating a blank screen. It should have auto-repeat capability.

Cursor Home: The home position of the VDT screen is defined as the upper left hand corner. Depression of this key causes the cursor to move to the home position regardless of where the cursor is on the screen. This key should not have a meaningless repeat capability.

Cursor to End of Text: The action of this key should be to move the cursor (regardless of where it is on the screen) to the first space after the last entered sign. If the last entered sign is not on the screen, it is a good feature to automatically roll the screen until that last sign is (normally) on the bottom line of the VDT screen and place the cursor in the first space after the last sign on the line.

Cursor to the Beginning of Text: The action of this key should be to move the cursor (regardless of its position) to the first entered sign in the copy that is being viewed on the VDT screen. If that positon is not viewable on the screen, an appropriate roll function should automatically take place resulting (normally) in the first sign being viewable on the first display line. The cursor should be placed on the first sign.

Cursor to the Next Paragraph: The action of this key should be to move the cursor to the beginning (first sign) of the next paragraph. The next paragraph is the first sign after a paragraph terminating code(s) or a paragraph indent code(s). Automatic roll, if this position is not on screen, is a desirable feature.

Set Skip: This is a feature which is very desirable to make text and typography changes; the character where the cursor was is stored in memory. This 'sets' the sign to which the cursor will move when the skip key is depressed.

Skip: This key moves the cursor to the next occurrence of the sign that is set in the set skip of the material that is being viewed on the VDT screen. Automatic roll to place that position on the screen is desirable.

Back Skip: Moves the cursor to the previous occurrence of the skip defined sign. Automatic roll to place that position on the viewable screen is desirable.

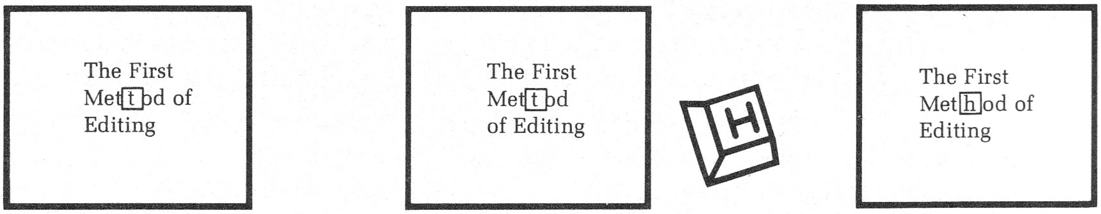
Define Search: Depression of this key allows a search mask to be defined. A mask of 16 or more characters (signs) is good. Once the define search key is struck, the next keystrokes define the search mask.

Search Forward: Depression of this key moves the cursor to the first sign of the next grouping of characters (signs) as defined in the search mask. Auto roll is desirable as previously defined.

Search Backward: Depression of this key causes the cursor to move to the first sign of the previous grouping of characters (signs) as defined in the search mask. Auto roll is desirable as previously defined.

Grid Location: Defining areas such as a grid on the VDT display screen and having keys to move the cursor to areas defined by the grid are desirable features as long as the operations are easy for the operator to perform.

Since the cursor location is where the keyboard action manifests itself, it is very important to be able to rapidly and efficiently move the cursor to any desired location. Sometimes the editing operation itself takes far less time than moving the cursor to the desired location.



1. Position cursor.

2. overtype.

3. Corrected character appears.

Figure 32. VDT Character Editing — Overtype

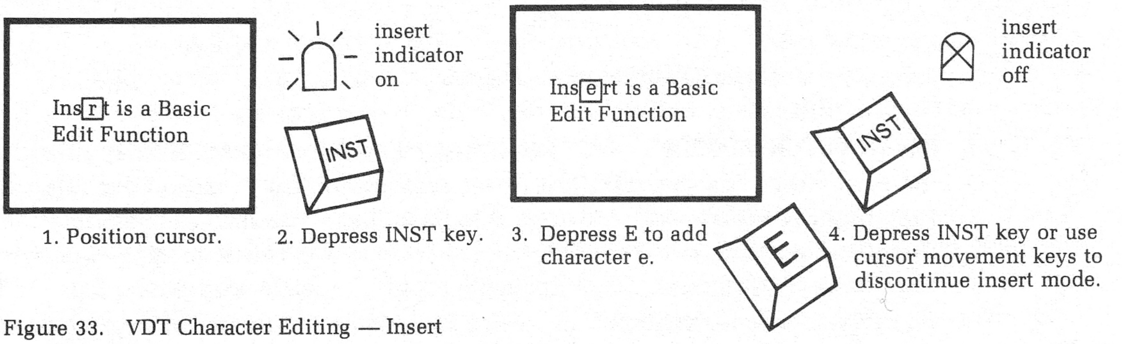
B. CHARACTER EDITING. Editing is basically the process of changing the material viewed on the VDT. The first consideration is to position the cursor at the proper point where the change is to take place. The second consideration, the actual editing, is to make the change. Once the cursor motions are mastered, the VDT operator should have rapid access to any portion of VDT memory/screen for editing purposes. This editing consists of replacement, insertion, or deletion of individual characters, words, sentences, paragraphs, or blocks of text. The whole name of the game in making editing changes is to minimize operator time by minimizing the number of keystrokes, making the keystroke less difficult, and having the operator experience minimum delays when the change is taking place. Delays can destroy the VDT as a useful tool in the text-processing cycle. When large clusters of terminals are connected to one host computer (processor) the delays can often become intolerably long. The functions of roll up and roll down are particularly taxing to the host computer system and normally create the longest delays. The following two editing functions are generally the most prone to delays:

1. The insertion of a character (particularly at the beginning of the memory or screen).
2. The move functions such as move sentence, paragraph, and block (particularly if the move is from the end of memory to the beginning of memory).

Character Editing: The process of making changes, one character (sign) at a time is called character editing. Most complex text edits are done on this basis. However, they are done (or should be done) so rapidly that the eye cannot detect the character-by-character action. Most editing functions can be accomplished on a character-by-character basis, so a firm understanding of character-by-character (sign-by-sign) editing aids in the understanding of block type edits.

Overtype Character: The normal method of VDT editing is 'overtype'; the operator moves the cursor over the character (sign) to be changed, and presses the desired alphanumeric (sign) key. This replaces the character (sign) previously at the VDT screen location with the new character.

Insert: Overtype is good to correct a typed mistake but if a character or sign is missing, the insert function must be used. This is not a replacement operation; it permits the insertion of a new character (sign) or character (signs) and automatic expansion to make room for the additions. The VDT operator moves the cursor to the postion following the missing character, then places the VDT in insert mode by pressing the insert key. Normally, an indicator light will show the VDT to be in the insert mode. When the new sign is typed, the



1. Position cursor.
2. Depress INST key.
3. Depress E to add character e.
4. Depress INST key or use cursor movement keys to discontinue insert mode.

Figure 33. VDT Character Editing — Insert

sign the cursor is on and all signs to the right, will move one space to allow room for the insertion. Word formats should be saved at the end of lines (called word wrap) and paragraph integrity must be preserved. The VDT should remain in the insert mode until the insert key is depressed a second time or the cursor is moved.

The insert functions are not merely replacement operations; rather these functions should spread the existing text to allow additional characters to be inserted into the space between the cursor location and all preceding material. This further enables the operator to add new or previously omitted information on a character-by-character basis without disturbing the original text.

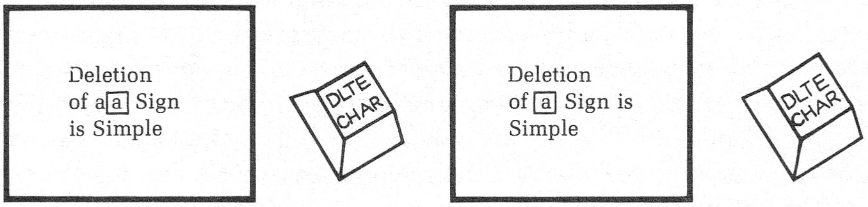
Delete Character: The delete character (sign) is the inverse of insert in that signs are normally removed. The remove operation can be highlighted by requiring two depressions of the delete key. The first one would cause the character to blink and the second depression would remove the sign (character) at the cursor location as shown below. Auto repeat of this key would override the blink for every character except the first character.

C. TEXT EDITING (DELETE FUNCTIONS). Text editing normally refers to manipulations of the displayed signs on the VDT in blocks of more than one at a time. The ability to perform some operations on blocks will save a great deal of operator time. Most text editing can be accomplished on a character editing basis with the attendant loss in operator time.

Generally, delete functions refer to the deletion of characters, words, sentences, lines, or paragraphs from text, and the automatic closing up of the following material to eliminate any gap. Line-endings, word and paragraph integrity, should be preserved in the material below the point of deletion.

In general, delete functions should require two key depressions. The VDT operator positions the cursor over the character or within the word or portion of text to be deleted, then depresses the corresponding delete key once. This should cause the selected portion of text to blink. A second depression of the key removes the unwanted material and closes up the remaining text while maintaining word, line and paragraph integrity.

Delete Word: This function deletes (removes) a word from the VDT display screen with two strikes of a single key (DLTE/WORD). The cursor does



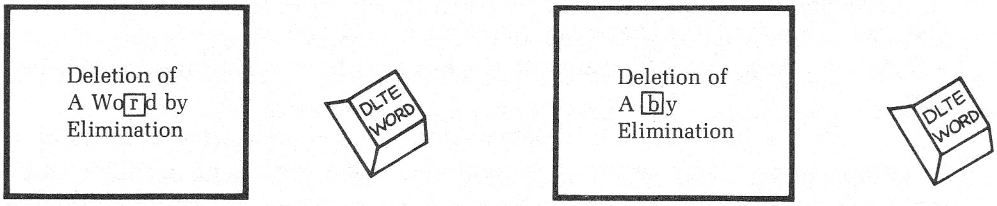
1. Position cursor.

2. Depress DLTE/CHAR key.

Note that the text is closed up and lines end only at the end of a word on the right margin (word integrity).

Figure 34. VDT Character Editing — Delete

not have to be on the first letter of the word that is desired to be removed. If the cursor had to be on the first character of the word it would mean extra keystrokes for the VDT operator. The first strike of the (DLTE/WORD) key should highlight the word by some signal such as blinking the word. The second keystroke should perform the action maintaining word and paragraph integrity as shown:



1. Position the cursor anywhere in the word to be deleted.
2. Depress DLTE WORD key, word selected is flashed (blinked).
3. The operator verifies the correct word is selected (blinking).
4. The DLTE WORD key is depressed a second time. The word is deleted, text closed up, word integrity retained.

Figure 35. VDT Word Editing — Delete

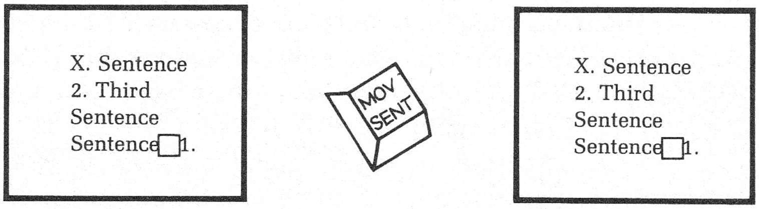
Delete Sentence: This function is similar to delete word only that it operates on an entire sentence regardless of how many lines or portions of lines the sentence may occupy on the VDT screen. Two key depressions should be required to perform sentence delete functions. The first depression causes the selected sentence of text to blink; the second depression actually deletes the information. This first depression blinks the sentence and allows the operator to make a final check before deleting the sentence; the recovery procedure is to depress any key other than sentence delete.

Delete Paragraph: This key should perform a delete on an entire paragraph regardless of where the cursor is located in that paragraph or regardless of how many lines or parts of lines the paragraph occupies on the VDT screen. Its operation should be similar to delete word and sentence except that it operates on an entire paragraph. It is interesting to note that trailing spaces should automatically be removed by the delete functions or the cursor will have to be positioned on the normally unseen spaces (spaceband) and a character delete performed. It is interesting to note that when looking at a VDT screen, one cannot see the difference between a space created by depression of the space bar and an unoccupied space on the screen. The space bar space enters a code in memory which must be output to the phototypesetter, or the words would be set without interword spaces. The unoccupied space has no such code in memory, particularly if the memory has an organization commonly referred to as 'efficient'.

When handling tabular data (which cannot be conveniently done with an efficient memory organization) a line remove is very desirable. Line remove should merely remove one line on the VDT screen (the line the cursor is on) and roll-up all remaining lines one line position.

D. TEXT EDITING (MOVE FUNCTIONS). Moving is the ability to move predefined blocks of text such as a sentence, paragraph, or operator defined portions of text called blocks, to any location on the VDT screen indicated by the cursor, and to move the information into that cursor position in insert mode. Single character and word moves are hardly desired since they can readily be performed by the character insert and delete functions.

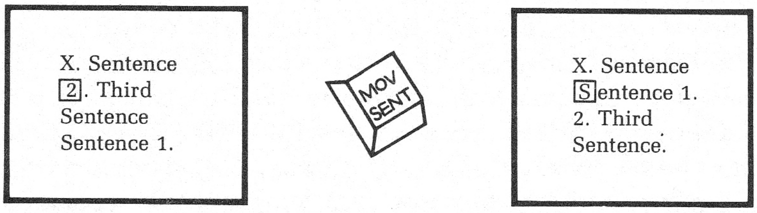
Move Sentence: This key should allow the operator to move a sentence to a new location. First the cursor is positioned within the sentence *to be moved,* then the *MOV/SENT* (move sentence) key is depressed and the sentence should begin to blink. The first character of the sentence and the space band following the terminating punctuation mark should be the sentence delimiters. The VDT operator next moves the cursor to the character one position left of the desired new location; he then presses the *MOV/SENT* key a second time. The delimited sentence moves to the new cursor location, and the space it previously occupied should be closed up. Text following the new location (cursor position) should expand to make room for the sentence insertion. If a sentence selection error has been made, the operator can recover while the text is still blinking by depressing the RESET key.



1. Position cursor anywhere within sentence to be moved.

2. Depress MOV/SENT key.

3. The operator verifies the correct sentence is selected (blinking).

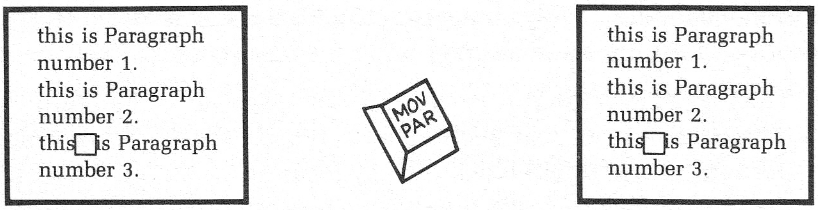


4. Position cursor at new location for the selected sentence.

5. Depress MOV/SENT key a second time.

6. The sentence is moved, the text is closed up, and word integrity maintained.

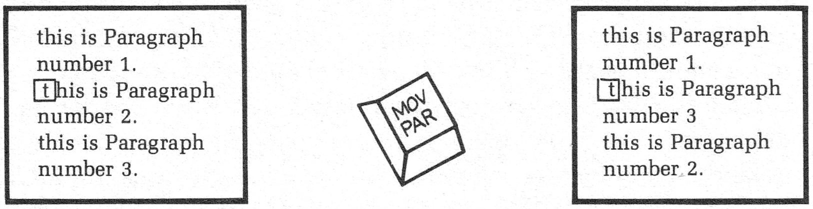
Figure 36. VDT Sentence Move


this is Paragraph
number 1.
this is Paragraph
number 2.
this is Paragraph
number 3.
MOV
PAR
this is Paragraph
number 1.
this is Paragraph
number 2.
this is Paragraph
number 3.

1. Position cursor anywhere within paragraph to be moved.

2. Depress MOV/PAR key.

3. The operator verifies the correct paragraph is selected (blinking).


this is Paragraph
number 1.
this is Paragraph
number 2.
this is Paragraph
number 3.
MOV
PAR
this is Paragraph
number 1.
this is Paragraph
number 3
this is Paragraph
number 2.

4. Position cursor at new location for the selected paragraph.

5. Deptress MOV/PAR key a second time.

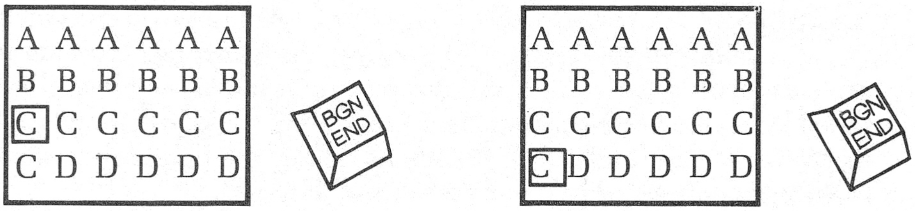
6. The paragraph is moved, the text closed up and word integrity maintained.

Figure 37. VDT Move Paragraph.

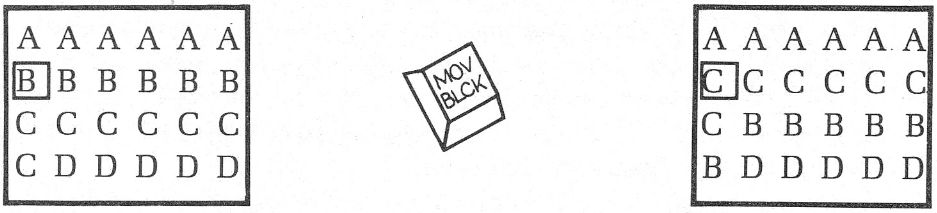
The memory address of the first character of the sentence and the trailing space band of the sentence ending character should be retained by the VDT logic. The VDT operator must be able to move the sentence to any desired location even if the blinking sentence is rolled down or up off the screen.

Move Paragraph: This VDT function allows the operator to move or insert a desired paragraph of text to any selected location in text. The location the paragraph is moved from should be treated as a delete operation, e.g., as the paragraph is moved, the space it occupied is appropriately closed up. The location it is being moved to is normally handled as a multi-character insert operation. Operationally, the VDT operator would move the cursor to anywhere within the paragraph then depress the MOV/PAR (move paragraph) key. The delimited paragraph of text would then begin to blink. The operator would then move the cursor to the location to which the paragraph is to be moved, and if desired, he can roll the selected paragraph off screen to get the cursor to the new desired location. The MOV/PAR key is again depressed and the desired paragraph is moved to the current location of the cursor, and its previous position is appropriately closed up.

Move Block: This function should allow the VDT operator to move an arbitrarily defined block of text to any new location. This operation requires two control keys: one to define the beginning and end of block *(BGN/END)* and another to cause the move to take place *(MOV/BLOK)*. Basically the VDT



1. Position cursor at the beginning of the block
2. Depress BGN key which defines the start of the block
3. Position cursor at the end of the block
4. Depress END key which defines the end of the block
5. The operator verifies the correct block is selected (blinking)



6. Position cursor at new location for the selected block
7. Depress the MOV BLOCK key
8. The block is moved, the text closed up and word integrity is maintained.

Figure 38. VDT Move Block

operator would position the cursor at the beginning of the desired block and depress the appropriate key shift plus the *BGN/END* keys thus storing the beginning (location) address. The cursor should next be moved to the last character (which may be a space) of the block. The VDT operator then strikes the appropriate key, (unshift plus the *BGN/END* key) saving the end of the block address. The block of text should then begin to blink. The VDT operator then moves the cursor to the desired new location with appropriate roll down or roll up if required and presses the appropriate key *(MOV/BLOK)*, and the previously mentioned block of text is inserted at the new cursor location. (See Figure 38)

E. DELIMITERS FOR EDITING. In order for the VDT to perform direct editing functions on words, sentences, and paragraphs it should be intelligent enough to recognize what constitutes the beginning and the end of words, sentences, and paragraphs. These beginnings and endings are called delimiters. In the ideal case, the delimiters should be user-defined and changeable for different types of work.

Delimiter for Words: In general, a space (space band) defines the beginning and the end of the word. The trailing space (space band) is normally considered as part of the word for an editing function such as delete word.

Delimiters for Sentences: In general, the following define the end of a sentence: period, question mark, exclamation mark, close quote (if it is preceded by a period, exclamation mark, or question mark), equal sign can sometimes delimit a sentence. The space following the punctuation should be considered part of the sentence for editing purposes.

Delimiters for Paragraph: These delimiters must be specified by the user and sometimes depend upon the codes required by the phototypesetter. An editing function such as delete should remove all signs, words, and sentences between paragraph codes including indent spaces and trailing end-of-paragraph codes.

F. CLEARING FUNCTIONS. These functions are used to clear large blocks of characters. When these clearing functions take place, it is generally a good procedure to have automatic white space close-up. Automatic white space close-up is a procedure where the space left by the deletion or movement of text is automatically deleted and the remaining text closed up. Normally the following clearing functions are available.

Erase VDT screen:

1. Completely
2. Before the cursor
3. After the cursor

Erase VDT memory:

1. Completely
2. Before the cursor
3. After the cursor

These explanations are almost self-evident so a detailed explanation is not necessary. It is generally a good procedure to require a two-keystroke operation. The first keystroke causes the text to blink (allowing the VDT operator to see what will be cleared) and the second, sometimes preceded by a shift key, actually performs the operation. Other types of clearing could include the following:

Erase only typography commands, not the text:

1. Before the cursor from the beginning of the screen.
2. After the cursor to end of the screen.
3. Before the cursor from the beginning of the VDT memory.
4. After the cursor to the end of the VDT memory.

Hierarchical clearing of these commands could also be useful, provided its implementation was not awkward.

Terminal Status Indicators. These indicators should allow the VDT operator to determine appropriate status information relative to the VDT operation. It is important that these indicators be appropriately placed to provide efficient terminal operation. These indicators should have long life. The new light-emitting diodes are ideally suited for this purpose. The more indicators on the VDT, the easier it is to use.

General Indicators:

1. Power On: Indicates when VDT terminal is powered.
2. Local On-Line: Indicates if VDT terminal is operating locally or with the central processor.

Edit Indicators:

1. Memory Alert: Indicates when VDT memory is nearing the full state.
2. Memory Full: Indicates when VDT memory is full.
3. Insert: Indicates keyboard operation is in insert (not overtype mode).
4. Keyboard Lock: Indicates keyboard is locked and transmission of data to and from main processor is occurring.
5. Text Only: Indicates that typography codes are not visible.
6. Typography Only: Indicates that text codes are not visible on screen.

12. TYPOGRAPHY INDICATORS

Tabulation on: VDT is tabular mode. (Normal is text mode)
Indentation On: Indented data is being displayed.
Cursor Position: Indicates position in typographic units that the cursor has moved from the left margin.
Cursor Remainder: Indicates from cursor the remaining typographic units to be used up to reach the set measure.
Units: Indicates whether relative or absolute units are used.
Set Depth: Indicates depth of copy to the line the cursor is on.
Kern on: Indicates kerning will be accomplished on the line the cursor is on.
Point Size: Indicates point size of word cursor is on.
Justify: Indicates VDT is operating in character-by-character justify mode.
Hyphenate: Indicates VDT will automatically break words at end of measure by logic rules.
Leading: Indicates 'normal' interline leading.
Typeface: Indicates the typeface the cursor is on.

13. JUSTIFICATION

An ideal VDT feature is an indicator which gives the position of the cursor in the measure and the remaining width to fill the desired measure. This is similar to the counting keyboard scheme with some very useful additions. The indicators should give the proper indications regardless of where the cursor has been moved. Full cursor movement, especially to backup a line(s) or a paragraph(s), is essential. This feature will allow the human operator, who in general cannot be bettered by a computer program, to set the text as desired. The operator can hyphenate the text perfectly, which no computer program can do. Mixing of point sizes within a line must be allowed. It should be possible to cancel the justification feature when inputting raw data. Ideally, if tabular data is displayed the cursor position indications should be relative to the tab settings.

14. HYPHENATION

Logic rules should automatically hyphenate the text 'on the fly', instantly as it is entered; thus, the operator can check the hyphens. Since rules prevent hyphenation of some words, a visual or audio signal could indicate to the operator that a word cannot be hyphenated or that the hyphen point used was questionable.

Oftentimes accuracy of hyphenation is given as a percentage of hyphenated words in text. For most types of work, including newspaper, this can only be a rough indication of how good the hyphenation routine is.

No computer program can out-perform a trained typographer in hyphenation. Often a great deal of expense is required in the computer system to obtain hyphenation. Unless a hyphenation program is tuned for a particular job (that can take years) the hyphens have to be checked by a skilled person. If the VDT can justify 'on the fly' as data is entered, the operator can check the hyphens at the entry point. This is an ideal method if intelligent operators are used.

15. EXPANDING THE STAND ALONE TERMINAL CAPABILITIES

Many users have purchased stand-alone terminals that punch paper tape. This paper tape is then processed by a typesetting computer which is either an entity in itself or an integral part of the computer in the phototypesetter.

To effectively utilize the stand-alone VDT (SAVDT), the VDT should be able to reprocess the output tape that is used to drive the typesetter; otherwise, to make corrections, the output of the typesetter must be interpreted by the operator and a new input tape must be created. A modern microprocessor could be used to perform the translation of the output tape into input form so that, in the event of a correction error in the output tape, it could be read directly into the SAVDT and the corrections made directly. If this translation is not made, an input tape (different from the output tape) must be located and changes made on it. Oftentimes, changing an input tape to achieve the desired output, requires a great deal of thought or guessing on the part of the operator. If the output tape could be viewed directly, a coding error would be much more obvious and easy to correct. It is important that the mark-up coding and symbols used on a VDT be similar to the prevalent typography mark-up symbols. Intelligence in the VDT, such as a mini or microprocessor, could allow similarity.

If an expansion of the SAVDT is planned, it might be appropriate to consider adding storage in the form of a floppy disk. This storage could be added at a very nominal cost. Other forms of storage, such as magnetic tape or paper tape, are not as desirable because of their sequential nature.

An intelligent VDT that has complete editing, reprocessability, instant justification and hyphenation, and is capable of directly setting complex type, has been recently introduced into the marketplace. With the addition of file storage and some other minor capabilities, this intelligent VDT goes a lot further towards meeting the total requirements of the trade than any of the other abundantly available or in-use VDTs. Remember, the name of the game is to set type with the minimum number of keystrokes. An intelligent VDT (IVDT) can set complex type with far fewer keystrokes than the widely used unintelligent

VDT. Even in straight matter, if the IVDT has instant, on-the-fly justification and hyphenation, clean copy can almost always be obtained in the first pass.

An IVDT would eliminate the need for special VDTs to perform special jobs. None of the available VDTs are ideal for both news (straight matter) and complex matter (grocery ads) or even semi-complex (classified ads). An IVDT could span all three of these requirements merely by using different programs.

The intelligent terminal can be used as the first building block in a complex system and the building can be done in a step-by-step manner. The IVDT allows a slow, controlled approach rather than a traumatic plunge into electronic systems.

CHAPTER THREE

STORAGE MEDIUMS

A. PAPER TAPE

The data to be worked on by a computer must be stored in some manner in digital form to be understood by the computing system. In a stand-alone VDT, this medium has generally been paper tape. Paper tape has been used in the industry since the early days of automation, e.g., tape driven linecasters. Other more computer-oriented media such as magnetic tape and flexible (floppy) disk are just recently making their appearance.

Paper tape has proven to be a dependable storage medium although it is not without problems. Paper tape has been used extensively in the working environment of a composing room to drive linecasters. Since the linecasters are not completely accurate in their operation, the accuracy demands on the paper tape were not great. One seldom knew or cared in the event of an error, whether the tape or the caster caused the problem — the line was merely reset.

One of the problems with paper tape is the difficulty of reading what it contains. Sometimes a visual header is punched on the tape as a name tag. The visual header consists of hole patterns that approximate the standard alphabet so that a single row of hole patterns does not have to be translated into alphabetical characters. Many operators become very proficient at reading and translating the single row of holes on the tape into alphabetical characters.

The information contained on the linecaster drive tape was primarily alphabetical with few machine control codes since the composition consisted of hot metal carpentry. The loss of or an error in the control codes did not occur very often and if it did, the work was simply redone.

With phototypesetting, the number of control codes in proportion to the alphabetical material is much larger than for hot metal. Thus, the probability of an error being in the control codes is much higher. The demands on the accuracy of the storage medium are much greater for cold type (phototypesetting) than for hot metal. Paper tape, if it is handled correctly, is a sufficiently accurate storage medium for cold type.

The phototyesetter installations normally take the paper out of the hot metal shop

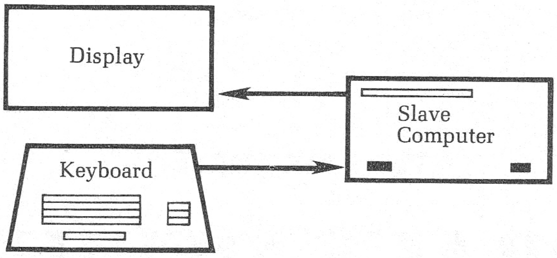


Figure 39. Intelligent VDT (IVDT)

where it is sometimes walked on, torn, or drenched with oil; paper tape then becomes a more reliable storage medium.

Early VDTs were nothing more than devices which allowed the operator to read the paper tape that was usually prepared on a tape perforator, make corrections, and punch an output tape. More often than not, this output tape could not be read back in and corrected. If corrections had to be made, the old input tape was read in to the point of the desired correction, the correction was made, and a new output tape was punched.

With the advent of IVDTs the need to keep the input tape has been eliminated. Corrections can be made by reading in the output tape, making the correction, and producing another output tape. This feature is called reprocessability of the output. IVDTs are no longer mere translators of paper tape holes into VDT screen display images.

IVDTs are now effective instruments that can 'set' the type in proper form during the first pass. Very complex typography can be handled on an IVDT.

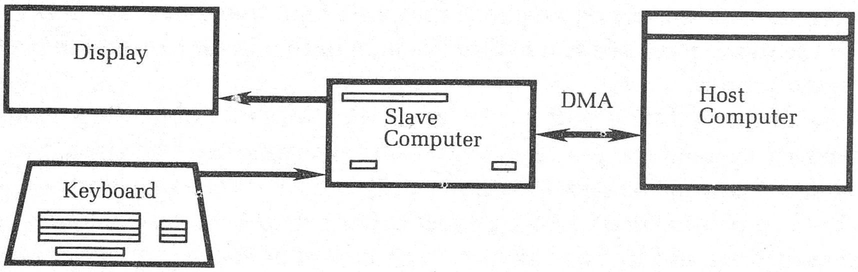


Figure 40. On-Line IVDT

1. INPUT

The input to stand-alone VDTs is usually paper tape, normally prepared in a punching bank. The tape primarily consists of text data with a few command codes imbedded therein. If this tape is processed in a VDT the accuracy of the tape is not critical since errors can be detected and corrected very easily.

Modern electro-optical tape readers can tolerate a great deal of hole elongation and misalignment that is prevalent in many paper tapes. These readers have greatly reduced the tape quality requirements necessary for the older mechanical type readers. Resorting to a Mylar (rather than paper) tape is usually an unnecessary luxury since dimensional stability of the tape is not very critical. Tape-fed mechanisms on the new readers are considerably better than on the older types. The older mechanical types generated a great deal of electrical noise (not acoustic noise) which had to be filtered out of the logic circuits.

2. OUTPUT

Output tape is defined as that which is output from the punching bank or VDT, and is used to drive the typesetter. Producing a paper tape with a paper tape punch at high speeds is not a simple task. The punches wear and the tape becomes sloppy. Mylar tape is particularly wearing on the punch. Punches generate a great deal of acoustic and electrical noise and are not very compatible with human beings or electronic computers.

The accuracy requirements for the output tape are more stringent than for the input, because the former drives the typesetter and contains the control codes. Errors in control codes are much more troublesome than textual errors since they are more difficult to correct and can often require a complete rerun rather than a cut and paste correction.

Keeping some of the older punches in adjustment under heavy use conditions was very difficult. The newer punches, with their modern steel alloys, are very reliable and require simple replacement of the cutting surfaces rather than total replacement and complicated adjustments.

Paper tape is a medium that will be reluctantly given up since it is something tangible. It can be seen, stored, and read (reading may be difficult).

The magnetic media do not have such advantages. By looking, one cannot tell the difference between empty or full tape. It is impossible to visually read (without magnification) the contents of magnetic tape. Paper tape will be around for quite some time.

3. DATA RATES FOR PAPER TAPE-BASED STORAGE DEVICES

Paper tape-based storage devices tend to be slow, variable-rate devices. Paper tape readers operate below 600 characters per second; punches operate below 150 characters per second. Card readers and punches operate below about 400 characters per second, OCR readers operate below 1000 characters per second, and line printers operate below 1200 characters per second. Keyboards, of course, operate at the speed of the typist, which is generally well below 10 characters per second. Except for keyboard data, it is possible to slow down or stop these devices should the computer wish to decrease its input. This fact, coupled with the low data rate, means that this class of devices usually communicates with the processor of a computer directly via programmed data transfer rather than by direct memory access, which is used with the faster fixed-rate magnetic storage devices.

B. ELECTRONIC STORAGE DEVICES

1. GENERAL

In order for a computer to perform useful work, it must have work to perform, data, programs, and the ability to perform the work. Both the data and the programs have to be stored in the computer memory called 'core'. The core memory (lately solid state circuits are being used in this function) is costly and cannot be large without bounds. For the computer to handle a great deal of data or store a large number of programs, means other than core (primary storage) had to be devised. These other means are called secondary storage. They should be utilized in such a fashion that the computer feels the information in the secondary storage is virtually in core. Most medium and large scale typography computers utilize some form of secondary storage.

2. TYPES OF SECONDARY STORAGE

Secondary storage includes direct access storage devices (DASD), magnetic tape, and paper-based storage. DASD are useful for allowing rapid on-line access to data with little or no waiting time. Tape and paper-based storage are used to store information which does not have to be accessed on-line, and to allow transfer of information between systems when DASD are not available. DASD include magnetic storage disks and drums with either fixed or removable media, and range in performance from very fast drums to floppy disks. Magnetic tape includes both the reel-to-reel and cassette varieties. Paper-based storage includes punched paper tape equipment, punched card equipment, optical character recognition (OCR) equipment, and the printer-typist-keyboard combination.

3. DATA RATES FOR MAGNETIC STORAGE DEVICES

Data rates vary widely for all three classes of secondary storage devices. Disks and drums (other than floppy disks) typically range in data rate from 100,000 to 1 million characters per second, with floppy disks close behind at about 300,000 characters per second. Magnetic tape data rates typically vary between about 100,000 characters per second for high-performance reel-to-reel tape units, down to around 500 characters per second for most kinds of cassette equipment. In addition, an incremental tape unit can transfer at rates ranging from 10,000 characters per second down to zero, at the option of the computer (or other device) that is using it. Except for incremental tape transports, all of the devices mentioned must transfer data at their own speed, implying a certain amount of unavoidable loading on the computer while the device is in use. Thus, high transfer rates imply high performance but consume a portion of the speed capability of the system; the computer slows down to a degree while these devices are transferring information.

4. LATENCY

The primary factor that distinguishes DASD from other secondary storage devices is latency, the time required to acquire information once it has been identified. Whereas paper-based and magnetic tape storage requires minutes to access, data stored on DASD can be accessed in fractions of a second. Drums and disks have two sources of latency: rotational latency, the time required for the device to rotate to the position where it is to be read or written; and seek time latency, the time required for a moving head or heads to move to a selected track. Some DASD with one head-per-track devices have no seek time component of latency; such devices are especially useful where many requests for data on different tracks can occur at once because the requests can be sequenced to minimize rotational latency regardless of the order in which the requests were made, thus giving high performance in this application. The capacity of any of the secondary storage systems with removable media is almost unlimited. If the medium is not removable or if on-line access is required, then the capacity of the DASD is significant. Fixed head DASD store a few hundred thousand characters whereas moving head DASD increase this number to tens of millions of characters. A floppy disk will store perhaps a quarter-million characters. With removable media, a more significant measure of storage capacity is the cost and convenience of the system used to file the media. For this purpose, it should be noted that the capacity of a reel of magnetic tape ranges up to 70 million characters and the capacity of a cassette or floppy disk ranges between one-quarter and one-half million characters.

A 1,000 foot roll of paper tape can store 120,000 characters. A box of punched cards can store about one-quarter million characters. Thus magnetic tape is a very efficient means of mass storage compared even with paper, which can store only a few thousand characters per page.

5. ENVIRONMENTAL CONSIDERATIONS

Magnetic storage devices, vis., DASD and magnetic tape, have environmental constraints which must be observed if they are to work reliably. Besides the usual temperature and humidity limits required by all forms of electronic equipment, removable magnetic storage media must be protected from fingerprints and particulate matter in the air, and must not be exposed to strong magnetic fields found around heavy electrical equipment (such as presses). Paper-based devices, especially paper tape readers and punches, are much more tolerant of harsh environments.

6. RELIABILITY

All of the secondary storage media discussed above are reliable when properly used. The reliability of a secondary storage system is strongly related to the complexity of the devices required to handle the medium involved, balanced against the data rates of the devices.

CHAPTER FOUR

CENTRAL PROCESSING UNIT (CPU)

A. MANUFACTURER

Knowing the manufacturer of the computer will give some indication of how long the computer has been in use, the number in use, and the stability of the manufacturer. In general, one runs a risk if the computer is less than one field-year old since it takes about that long to find the last bugs and bring the documentation to the point where it is reasonably complete. One runs a great risk by utilizing a computer made by a manufacturer that might not be around for the life of the system; the life of the system can be safely assumed to be five years or more. Some consideration should be given to servicing of the computer since the system vendor will have to fall back on the computer manufacturer for some of this.

B. TYPES — MODEL NUMBERS

The model number of the computer will indicate the age of the type of computer and its relationship to other computers made by the same manufacturer. Some computers have unique architectural features which make them more adaptable to time-shared editing and composition than the classical varities. Sometimes these unique features simplify the programming and impart speed to the system. For example, use of direct memory access by the terminals and I/O devices is a very nice feature in that it usually means that the normal computer routines can handle the terminals and I/O without complex, special I/O program routines and complex, costly, special purpose hardware.

C. DATA WORD SIZE

The data word length is important to know since it indicates how many tags can be carried with each character-defining code. For example, to define an 'N', eight bits might be used to differentiate the 'N' from all the other characters and four bits to indicate its width. Thus, a 12 bit data word could contain the character code and its width. The computer would not have to go looking somewhere else for the width of the 'N'.

For some larger computers a multiple of data words can be represented in one machine word. To decide what the data word size is, look for the largest number of bits that can be handled by more than a few instructions. For example, an IBM 370 may operate on 8 bit bytes as well as 16 bit half-words and 32 bit words, but with all but a few exceptions, cannot handle double-words of 64 bits. By this definition, the data word size of the IBM 370 is indeed 32 bits.

The data word size is very important since it has a direct bearing on the speed of the system and the complexity of the programs. A 12 bit data word size is adequate to represent in one byte most of the parameters necessary for composition of text; however, a 16 byte word is preferred. The smaller the word size, the smaller the number of locations that can be addressed in core (CPU memory). The necessity for utilizing more than one word to represent a memory address complicates the programs and reduces the speed of the computer.

In general, any computer with less than a 12 bit data word size should not be considered satisfactory for real time editing and composition. It would be like trying to haul a 4-ton load in a 1-ton pickup truck. Perhaps the truck could do it in four runs, but that would take four times as long. The limiting factors in the various systems are a function of the system's architecture and the dynamic load. More often than not, the computer CPU is the limiting factor in the system performance. An 8 bit byte computer would have a great deal of difficulty running a real time text editing and composing system.

D. PROCESSOR SPEED

Each instruction executed by the central processor of the computer takes a certain amount of time. Some instructions are used much more frequently than others, but it is possible to define an average instruction execution time. If the data word size is divided by the average time to execute an instruction, the result is the processor speed in bits per second. This number is biased somewhat in favor of computers with large word sizes. For computers with word sizes of 16 bits or less, it provides a fair index of computing power for typesetting applications. Typical processor speeds range from about 1 million to 32 million bits per second for minicomputers and microcomputers.

E. MEMORY SPEED

The memory speed can be determined by dividing the time required to read or write the memory (called the cycle time of the memory) into the data word size. This number lies in the same range as processor speed and is usually closely related to it. If processor speed is significantly slower than memory speed, it usually means only that multi-word instructions are common. The memory speed is used to give an indication of the maximum rate that direct memory access can transfer information between memory and the I/O devices.

F. ADDRESS CAPACITY

Address capacity is very important especially on minicomputers. Most minicomputers can only address about 216 to 218 words, or between 65,536 and 262,144 locations. It is very easy to run completely out of addresses when designing a large system with such computers. For example, a system to handle 16 different CRT terminals on a computer that can only address 65,536 different locations would allow only 4,096 locations per CRT terminal. Minicomputers which can address large numbers of locations are still unable to allow all locations to be accessed conveniently by the same program, but this is a virtue in multi-user systems because each user will have a large private collection of locations that no other user should access.

G. RELATIVE ADDRESSING

When the processor executes an instruction which addresses information in the memory of the computer, various optional addressing modes are possible. One of the more valuable of these is relative addressing, in which the information to be handled is addressed not by where it actually is in the memory (direct addressing) but by how many locations before or after the current instruction it is. If a program addresses all of the information integral to itself by means of relative addressing, then it can be used anywhere in memory. A program with this desirable property is called position independent; relative addressing makes position independence possible.

H. INDEXED ADDRESSING

Another important addressing mode is indexed addressing, in which the contents of an index register is added to the address specified in the instruction. A computer may have several index registers, or it may have general purpose registers which can be used to hold data as well as addresses for indexing. In these computers, the programmer can specify which register is to be used for indexing. Indexing allows the processor to access consecutive memory locations; this occurs very frequently in text processing applications. The index register to be used is set to the location on the first character to be processed and then stepped through the character locations one at a time. Moving a text string from one place in memory to another can be done most conveniently with two index registers.

I. INDIRECT ADDRESSING

Sometimes it is necessary to perform computations on the address of the data rather than on the data itself. Indirect addressing is a mode which treats the contents of the memory location being addressed as the address of another location in memory which contains the data (one-level indirect addressing). Indirect addressing can be used to access consecutive memory locations just as indexing does; in this case the indirect address in memory is stepped through the consecutive locations. A computer which does not have either several index registers or indirect addressing is not well suited to text processing. Computers with indirect addressing but not indexing, such as the Digital Equipment Corporation PDP-8, often have autoincrement or autodecrement locations which automatically step through consecutive memory locations as they are used indirectly.

J. OTHER ADDRESSING MODES

Sometimes the data to be operated on by an instruction is a constant which is examined but never changed by the processor. For such data, an addressing mode called immediate addressing is useful. In this mode, the instruction incorporates the data itself rather than the address of the data. Immediate addressing saves time and utilizes memory slightly better than is possible without it, but it is otherwise not particularly important. Some computers offer special hardware which allows automatic management of a (push-down) stack in memory. Many programs make use of a stack, but the automatic stack hardware does not save a great deal of time over a software implementation of the same thing, especially when index registers are available. However, the small time savings is important in interrupt handling where speed is often crucial.

K. INTERRUPT VECTORING AND PRIORITY

An interrupt is a way for an external process to notify the processor of a computer that an event has occurred. Examples of events which cause interrupts are completion of I/O operations, depression of a key on a keyboard, etc. Interrupts cause programs called interrupt handlers to be executed. Interrupt handlers take action appropriate to the event which caused the interrupt by vectoring the interrupt. Vectoring can be done by either hardware or software, but hardware vectoring is faster. When multiple interrupts are to be handled in a simultaneous way, priority interrupt hardware is useful to establish a hierarchy of interrupts.

L. INTERRUPT LATENCY

The time that elapses between the event that causes the interrupt and the point at which the interrupt handler can take action is the interrupt latency time. This time is, at worst, the sum of the time taken by the longest uninterruptable sequence of instructions in the program being interrupted, plus the time required to save the various registers of the processor so that they can be restored to their original state after the interrupt handler is through using them, plus the time required to vector the interrrupt. The interrupt latency time partially determines the maximum rate at which events may occur without loss of information in applications involving input which the computer cannot slow down or stop (wire service input, for example).

M. POWER FAIL INTERRUPT

A power fail interrupt provision is useful in systems where data must not be lost when the power fails. As the power to the computer starts to fail, an interrupt occurs and the processor has enough time to save its registers (as for any interrupt) before loss of power destroys the contents of those registers. Power fail interrrupt is not useful if too much data is lost on power failure for the processor to be able to restore it; this would probably be the case if the entire memory contents of the computer were lost on power failure (volatile memory). Some power fail interrupt systems provide for automatic resumption of the program when power is restored to the computer.

N. INSTRUCTION SET

The instruction set of the computer has instructions powerful enough to handle text processing. There are a number of desirable features an instruction set might have to enhance its text processing power. Fixed-point multiply is one of these; multiplication occurs very frequently in justification of text. Another feature is byte handling capability (in computers with word lengths longer than 16 bits) or, in general, the ability of the programs to deal with a byte (a portion) of the machine word in a convenient way.

CHAPTER FIVE

TYPOGRAPHY PROGRAMMING

A. TYPOGRAPHIC COMMANDS

1. GENERAL DEFINITIONS

Typography is a computer process of merging commands and text to produce output instructions for the phototypesetter and to cause text to be set in the required spatial relationships. The input commands are called the mark-up language. The output codes and commands are used to drive the typesetter. The typography programs should be written in reentrant fashion; this means that more than one job can be utilizing the typography programs and be processed independently of each other.

Ideally, the greater part of these programs should be written in a 'universal' language in order to be typesetter-independent. If the typesetter is changed, on most present electronic systems, new editing and mark-up procedures must be used — this is far from an ideal situation.

A. THE MARK-UP LANGUAGE. These are commands that must be entered into the system to make it perform the required tasks through the typographic routines. The language consists of keystroke entries in a prescribed location and order within the copy. These entries define different typographic configurations. The system language should be as close to the languages taught in journalism and printing education courses as possible. It should be easily understood; for example, a quad left command should consist of a command defining code such as an * followed by QL. Some mark-up languages are not easy to remember; this can be a disadvantage. Since mark-up is best done on a VDT, it would be convenient if the computer storage system had a file of the mark-up commands and their meanings. These could be called to the VDT screen at any time during the work cycle and processing of text with an automatic return to the copy work. For stand-alone VDTs there should be local memory to allow a screen presentation of the mark-up commands and their meanings. It makes little sense to have complex typography routines in the programs if they are not used because the operator forgot the command language. Some of the more complicated language commands are composites of simpler commands and may not be used since the operator will enter the composite of the simpler commands which he can remember.

With computation power being built into the typesetters in the form of minicomputers and microprocessors, a host of mark-up languages have come into being; they are all different, which is not an ideal situation. In evaluating any type of electronic system, the mark-up language is a very important ingredient since it directly affects the number and type of keystrokes required to set material. The language should be simple, powerful, easy to remember, and easy to key in. With simple matter, the mark-up language requirements are less stringent. With complex matter, the mark-up language requirements are almost paramount in importance.

B. FINAL FORM EDIT. If the system does not allow editing of the final copy (i.e., processed and ready to drive the typesetter) it has a great weakness. In a stand-alone VDT this consideration means that the typesetter driver tape can be read in, edited and then repunched. An IVDT is ideal here since it has the internal computer power to perform the reprocessing necessary to allow this final form edit. Response time of the system to a given command is very important. Systems that take over ten seconds to justify a 4000-character job are undesirable.

2. TYPESETTING FUNCTIONS

The following is a list of the functions a fully matured typesetting program should be able to accomplish.

Quad Command
Quad Left
Quad Right
Quad Center
Quad Middle (Split)

Tab Command
Tab Left
Tab Center
Tab Right
Tab Around
Tab at Text
Tab Justify
Tab Leader/Blank
Tab Proportionally

Rag Command
Ragged Left
Ragged Right
Ragged Center
Ragged Middle
Basic Commands

Line Length (measure)
Type Face
Point Size
Set Size
Vertical Movement Commands
Leading
Additional Lead
Zero Lead
Forward/Reverse Leading

Immediate Leading

Baseline Jump
Superior by Character
Superior by Block
Inferior by Character
Inferior by Block
Return to Marked Point
One Shot Reverse Leading
One Shot Forward Leading

Insert Commands
Insert Leaders Aligned
Insert Leaders Non-Aligned
Insert Character Defined X Aligned
Insert Character Defined X Non-aligned
Insert Rule(s) Horizontal
Insert Leader Aligned on Period
Insert Leader Non-aligned on Period
Insert Left Aligned
Insert Right Aligned

Overset Commands
Supplementary Line Length
Overset Line Left
Overset Line Right
Hanging Punctuation (automatic)

Space Commands
Letterspace (automatic)
Maximum Letter Spacing (automatic)
Letterspace by Character
Letterspace by Block
Kern (automatic)
Kern by Character
Delete Kern (automatic)
Delete Letterspace (automatic)
Specify Maximum Interword Space
Value at which Point Letterspacing Proceeds in a Hyphenated Line
White Space Reduction (automatic)
Interword Space
Single Time Interword Zero
Set Average Interword Space Value
Set Maximum Interword Space Value
Set Minimum Interword Space Value
Change Variables to Fixed Spaces
Change Fixed Spaces to Variables
Zero Set
Figure Space
Fixed Space
Relative Unit Space
Em, En, Thin Space
Center Accent (character)
Vertical Justification

Indent Commands
Delay Command
Run Around Left
Run Around Right
Run Around Left and Right
Indent Left
Indent Right
Indent Centered
Multiple Indent
Hanging Indent Left
Hanging Indent Right/Hanging Indent Centered
Indent to Text Left
Indent to Text Right
Automatic Paragraph Indent on Quad Code
Indent Length Fit Left
Indent Length Fit Right
Indent Length Fit Left and Right

Hyphenation Commands
Hyphenate with Logical Rules
Hyphenate with Rules and Dictionary
Hyphenate with Dictionary
Hyphenation Disabled
Hyphenation Language Selection
Hyphenation after Maximum Space at X
Specify the Number of Letters Preceding or Succeeding a Hyphenation Point
Maximum Hyphenated Lines in Sequence
Disable Hyphenation for Next Word
Specify Minimum Length of Hyphenated Word
Prevent Hyphenated Widows

Discretionary Hyphen
Obligatory Hyphen
Automatically Generated Hyphen

Skew Commands
Skew Left
Skew Right
Skew Center
Reverse Skew Left
Reverse Skew Right
Reverse Skew Center

Format Commands
Create Format
Store Format
Use Format
Change Format
Nest Format
Chain Format
Define Macro (format with text)
Use Macro
Operator Statistics
Operator Identification
Slug Line Film and/or Paper
Tag Line Film and/or Paper
Page Folios (automatic)
Running Heads (automatic)
Output Device Verification of Set-Up
Pi-Mat (not in matrix)
Pi-Mat (in matrix)

Drop Initial
Raised Initial
Ligatures (automatic)
Ligatures Deleted (automatic)
No Flash
Normal Flash
Multiple Flash
No Flash until EOL (End of Line)
Horizontal Rule
Vertical Rule
Fractions (automatic)
Cut Film/Paper
Justify
Justify Inhibit
Define Number of Lines Mark X At X insert Y
X Not to Be Z of Line Length.
X Not to Be a Heading or Have Additional Leading
Define Number of Points (inches, etc.) Mark X
If X is a Normal Subdivision Insert 'Multiples' of N at n
Small Caps by Size Reduction
Punch/Store Visual
End of Take/Tape
End of Take/Tape with Lead
Halt Tape/Text Display and Continue
Start
Stop

Table Four. Typesetting Functions

3. DESIRABLE FEATURES

The following is designed to identify the most desirable features required by an electronic typesetting system. The features appear under six headings:

a. Set-Up Commands
b. Typographic Features
c. Hyphenation
d. Area Make-up
e. Miscellaneous
f. Programming Requirements

A. SET-UP COMMANDS. These are the general commands which must be entered into the typography programs before any text can be meaningfully processed and the type set.

Machine set-up commands are the commands necessary to get the typesetter ready to execute a job. Some typesetters give no electronic indication of which fonts are loaded. Some of the typesetters must therefore be manually conditioned. Ideally, all these operations should be performed by electronic instructions. The following is a list of these operations and their definitions:

Take number. The number allocated to the job or portion of a job to be set.

Operator number. The reference number allocated to operators which is used in the job heading or description to identify who keyed the text.

Line Length. The ability to specify the machine unit value, i.e., picas and points, ciceros and points, etc.

Point Size. The ability to specify the true point size value and not the sizing mechanism position which will produce the required point size.

Typeface. The ability to select a typeface by its acronym as opposed to selecting a position on the typeface master matrix.

Leading (Programmed leading). The ability to specify the amount of leading or line feed that will be advanced when each carriage return or end of line code is encountered.

Additional Leading. The ability to insert a defined amount of leading at the end of a line. This procedure is non-repeat and must be separately programmed each time it is to be used.

Immediate Leading. The ability to insert at the point of keying, a defined one time amount of leading.

Reverse Leading. The ability to specify an amount of leading which will be escaped in the opposite or reverse direction to normal leading.

Zero Lead. The ability to inhibit programmed leading for one line.

Baseline Deflection. The ability to displace characters in the vertical direction above or below the normal baseline.

Set Size. The ability to specify the absolute horizontal space allocated to characters independent of point size.

Electronically Slant or Oblique. The ability to slant or distort Roman or upright characters to simulate Italic.

Electronically Embolden. The ability to increase the image dimensions of the master characters to simulate bold characters.

Electronically Condense or Expand. The ability to condense or expand the character image and associated space to simulate a condensed or expanded character.

Electronically Lighten. The ability to reduce the image dimensions of the master characters to simulate light characters.

B. TYPOGRAPHIC FEATURES

Set Minimum Space. The ability to set the minimum interword space width for justified copy.

Set Maximum Space. The ability to set the maximum interword space width for justified copy.

Set Average Space. The ability to set the average interword space for quadded lines and ragged setting.

Zero Set. The ability to inhibit the escapement of a character or characters.

Figure Space. The ability to automatically access the space width of figures in the font in which text is being set in.

Fixed Space. The ability to specify an absolute value of space which is not modified by point size or set size changes.

Relative Space. The ability to specify a space value which is related to the point size and set size being used.

Em, En, Thin Space. The ability to specify these space values relative to the point size and set size specified.

White Space Reduction. The ability to automatically reduce the space allocated to characters in the higher point sizes to achieve more aesthetically pleasing results by tightening the fit of characters.

Center Accent. The ability to automatically position accents or diacritical marks above standard characters.

Kerning. The ability to automatically reduce the width of selected adjacent characters to obtain more aesthetically pleasing results.

Letter spacing. The ability to specify a defined letterspacing (space between letters) value.

Point Size Mixing. The ability to freely mix point sizes within a line.

Typeface Mixing. The ability to freely mix typefaces within a line.

Pi Character Selection. The ability to select any pi character and insert it at any point within the text.

Quad Left, Right and Center. The abiliy to place the preceding text being assembled on the current line to the left, right or center of the column width. The interword spacing is to be the minimum or average value previously set.

Ragged Left, Right or Center. The ability to set text to the left, right or center of the column width by inhibiting the normal justification process. The interword space to be the minimum or average value previously set.

Quad Middle (Insert Blank). The ability to insert spaces at a defined point within a line, placing the text on either side of the point to the left and right extremes of the column width.

Insert Leaders Non-aligned. The ability to insert leaders at a defined point within a line, placing the text on either side of the point to the left and right extremes of the column width. The leaders will not necessarily be aligned vertically.

Insert Leaders Aligned. The same ability as for Non-Aligned leaders except that the leaders are aligned vertically. That is the position within each line such that each leader is positioned immediately above or below the corresponding leader in the preceding or succeeding lines.

Insert a Non-Aligned Character. The same ability as specified for the insertion of aligned leaders except that any character can be specified in place of the leader.

Insert an Aligned character. The same ability as specified for the insertion of aligned leaders except that any character can be specified in place of the leader.

Insert Rule. The ability to insert rules at a defined point in the text to a width greater than the column width, to the full column width, or a specified portion of the column width.

Hanging Punctuation. The ability to automatically allow defined punctuation which appears at the end of a line to intrude or hang into the right hand margin space. Effectively, the line is overset by the width of the selected punctuation character.

Supplementary Line Length. The ability to specify a supplementary or secondary line length which will be set immediately to the right of the preceding line.

Overset Left. The ability to set text which will intrude into the left hand margin.

Overset Right. The ability to set text which will intrude into the right hand margin.

Indent Left, Right, Center (Both). The ability to indent text from the normal column margins from the left, right or both sides.

Hanging Indent Left, Right, Center (Both). The ability to select a hanging indent left, right or center.

Multiple Indent. The ability to specify more than one indent value for use in a block of text.

Indent to Text. The ability to specify the dimension of an indent by selecting the text whose width will constitute the indent value.

Hanging Indent Left, Right, Center (Both) Length. The ability to specify a hanging indent left right or center for a specified depth.

Paragraph Indent. The ability to automatically generate an indent of a previously defined value for the next paragraph when an end of a paragraph block for the preceding paragraph is encountered.

Tab Set. The ability to set the width of tabulation fields in absolute units for tabular and table setting.

Set Tabs to Text. The ability to generate the width of a tab by defining the text which will appear in the tab. The width of the selected text will therefore equal the tab value.

Tab Left, Right, Center (Both). The ability to quad text left, right or center within a tab without normally causing leading or line feed to be advanced or escaped.

Justify Tab. The ability to justify a line or lines within a tab field.

Insert in Tab. The ability to insert leaders, blanks, or characters, aligned or non-aligned in a tab field.

Set Equal Tabs. The ability to define a number of tabs which will be allocated an equal portion of the total column width. The calculation of the tab widths is achieved automatically.

Proportional Tabs. The ability to weight tabs so they have the required proportion of the column width. The calculation of the tab widths is achieved automatically.

Bypassing Remaining Tabs. The ability to automatically skip or bypass the remaining tabs in a line.

Skew Left. The ability to specify an increasing left indent for a specified depth. The incremental value of the increasing indent to be specified or automatically calculated from:

Maximum Line Length − Minimum Line Length/Depth = Total Indent Value/Number of lines = Incremental indent

Skew Right. The ability to specify an increasing right indent for a specified depth. The incremental value of the increasing indent to be specified or automatically calculated as above.

Skew Center (Both). The ability to specify an increasing left and right indent for a specified depth. The incremental value of the increasing indent to be specified or automatically calculated as above.

Reverse Skew Left. The ability to specify a decreasing left indent for a specfied depth. The incremental value of the decreasing indent to be specified or automatically calculated as above.

Reverse Skew Right. The ability to specify a decreasing right indent for a specified depth. The incremental value of the decreasing indent to be specified or automatically calculated as above.

C. HYPHENATION

Discretionary Hyphen. A hyphen inserted in the data to be processed that can be used as a point for hyphenation should the word in which it is contained fall at the end of a line during the process of justification. If the word does not require hyphenating then the discretionary hyphen is dropped or omitted on output.

Obligatory (Mandatory) Hyphen. A hyphen inserted in the data to be processed that is essential to the text and must be retained irrespective of its location in the text. During the process of justification, the obligatory hyphen can be treated as a normal permissible word break point.

Hyphenation. The ability to hyphenate words by selecting any one or combination of:

1. Logic Hyphenation Rules
2. System Exception Dictionary
3. Job Exception Dictionary
4. Operator Exception Dictionary

The desirable features of a hyphenation program are:

1. The ability to specify the maximum interword space value at which point the desired hyphenation takes place.

2. The ability to specify the maximum interword space at which point letterspacing begins in a hyphenated line.
3. The ability to specify the minimum number of letters preceding and/or succeeding a hyphenation point.
4. The ability to specify the maximum allowed number of permissible hyphenated lines to appear in sequence.
5. The ability to inhibit hyphenation.
6. The ability to disable hyphenation for the next word.
7. The ability to select the required hyphenation routines for a particular language.
8. The ability to specify the minimum number of characters for a hyphenable word.
9. The ability to enable hyphenation.
10. The ability to inhibit the use of discretionary hyphens contained in the text.

D. AREA MAKE-UP

Vertical Justification. The ability to specify in absolute units (picas and points, inches, etc.) or lines, the subdivision and/or justification of text vertically.

Area Make-Up. The ability to have multiple passes through the program based on the following instructions.

1. The ability to define a number of lines and 'mark' the point (The(X)mark is purely for internal machine reference and does not appear on the material set).
2. At point X insert Y. Y consisting of text or instructions which have previously keyed and are currently stored in the computer system.
3. Point X should not be less than a defined amount of the column width.
4. Evaluation of the position of X, i.e., is it at a normal end of line, does it occur on a heading, additional leading, etc.
5. Define the absolute distance of X from the beginning of text.

Delay Command. The ability to insert a command in a stream of text prior to the point at which it will be used. The monitoring of text which is being processed will initiate the stored command at the point in the text which corresponds to the stored location. By this method it is possible to specify that an indent should occur after eight lines of text prior to the justification of the text and the knowledge of precisely where in the text stream the indent will occur.

Run Arounds. The ability to specify indents in conjunction with the delay command, to leave spaces or holes in the text for illustrations, captions, or other material.

E. MISCELLANEOUS COMMANDS

Inhibit Exposure. The ability to select a character or characters and escape their width but inhibit the exposure of the character.

Allow Expose. The normal state whereby the characters in the text are set or exposed.

Automatic Generation of the Catch or Slug Line. The ability to specify the output device or queue.

One Shot Line Changes. The ability to change from stored commands, the typographic parameters for one line only and return to the previously set parameters automatically.

1. The change of typeface for one line.
2. The change of point size for one line.
3. The change of leading for one line.
4. Any combination of the above three parameters.

Force Justify (Squeeze Line.) The ability to override justification parameters to ensure that the defined text fits in one line.

Raised Initial. The ability to simply insert raised initials at the beginning of paragraphs.

Drop Initial. The ability to simply insert drop initials at the beginning of paragraphs.

Create Format (Generate Macro). The ability to store commands and/or text in memory for future or subsequent use by a format or macro call command.

Change Format (Macro). The ability of the operator to simply change format instructions.

Chain Formats. The ability to link formats and allow formats to select the next format subject to the results of the text matter which has been processed.

Nest Formats. The ability to imbed a format within a format.

Break Formats (Macros). The ability to discontinue a format so that text can be processed in the normal way and then returned to the format.

Multiple Flash. The ability to select a character and expose or set it a defined number of times without escaping the width of the character, i.e., the character image is superimposed a defined number of times.

Automatic Ligatures. The ability to specify combinations of characters from the input stream, that will automatically be combined on output as a ligature.

Fraction Generation. The ability to enter simple instructions which will generate split or non-standard fractions, i.e., 13/15 on input will generate $\frac{13}{15}$ on output.

End of take. The ability to automatically insert additional leading and initiate the cutting of the end product on command.

Simulate Small Caps. The ability to automatically reduce the point size of text set in capitals to simulate small capitals on command.

Visual Coding (Visuals or Visi-Coding). A routine which automatically takes a selected portion of a heading and punches it out in visual form on paper tape for operator reference.

F. PROGRAMMING REQUIREMENTS

The following are typical desired features of the typesetting programs from the point of view of a programmer:

Reenterant. The programs should allow a multiplicity of users each progressing at his own rate.

Table-driven output. Code translations and character transpositions should be stored in an output table. This will minimize the reprogramming required for different typesetters.

Hardware multiply and divide. Ideally these functions, because they are performed so often, should be done by hardware which is much faster than a pure software approach.

Common absolute unit of measure. Sign widths, measure, etc. should be specified in adequate absolute units rather than relative units.

Table-loaded defaults. Defaults should be loaded into a table that can be conveniently edited and changed.

4. DEFAULTS

The typography defaults are very important to the efficient operation of a system since they can, to a great extent, eliminate rework. A default is caused by a command that is given to a system that it cannot understand or cannot execute. When this occurs the system takes an action called default. The commands that the system cannot understand are easily handled since they can be recognized by the computer and an 'illegal typography command' answer can be given. Defaults for commands that cannot be executed, i.e., a measure set command that is too wide for the typesetter to set, must be thought through very carefully — should the typesetter set the material to its widest measure or should the system simply halt. The preferred way would be to indicate on the VDT screen that the measure command as entered exceeded the typesetter's ability to comply so the operator would have instant feedback and make the change immediately. When more than one typesetter is being driven by the system, things become a little more complicated. Suppose a font is called out that exists only in a narrow measure typesetter and the specified measure can only be achieved in the wide measure typesetter. The question is — should the font be substituted and the material be set on the correct measure with an indication on the set material that the font was substituted, or should the correct font be set to the widest measure possible or should the system stop and indicate the incorrect commands? Feedback should be given to the operator as soon as possible after the erroneous command is entered. Some of the early systems, which are real time edit and quasi batch typography systems, could not conveniently provide this feedback. For this and many other reasons, the preferred systems approach is to have real time editing and real typography with feedback to the VDT screen. With this kind of responsive system, each typography command, as it is entered, could be looked up in a table for validity and the appropriate action taken. Each system will have to be different for each different user and typesetter.

If a VDT exists in the system, it must be determined what the error message will be under the following conditions:

1. For typography:
   Measure command too wide — too narrow

Point size command too small — too large
Leading parameter too small — too large
Default paragraph indent
Font call out when font not in residence
Pi call out for non-existent pi
Pi character not in display font

2. For system (if no VDT exists, it must be determined what will happen if any of the below occur):

- Invalid monitor executive commands
- File type errors
  - file not found — call error — no such file
  - file in use
  - file empty
  - command error
- Storage full
- Check sum errors
- Directory full
- Format directory full
- Format call errors
  - no such format
  - format call error
- I/O device callout error

In addition to these default considerations, which occur when the system is asked to perform an improper action, another type of error can occur when information is left out; this is called an omission/default. It must be determined what the system will do when the following items are left out. A suggested solution is also given.

A. TYPOGRAPHY

1. No font call	a. Use last font specified b. Reject take and notify operator
2. No measure call	a. Use last measure specified b. Reject take and notify operator
3. No point size call	a. Use most common size b. Set at last point size specified
4. No vertical depth	a. Set until last page size specified is full b. Regard set material as continuous string
5. Command incomplete	a. Disregard b. Notify operator

B. FOR ELECTRONIC SYSTEM

1. File name not complete	a. Do nothing until command is complete
2. Format name incomplete	a. Disregard b. Notify operator

5. WIDTH TABLES

Loading of the width tables into a system may seem like a simple task. The first thing to determine is if the typography programs utilize relative or absolute units. The number of allowable units (including fractions) must be determined if relative units are used and the unit of measure if absolute units are utilized.

The width tables for each font must be determined and converted (if necessary) into the units that the typography programs can utilize; sometimes this is not an easy task.

Once these width tables are in a form that the computer programs can use, they must be loaded into the system. For stand-alone VDTs a width table can be 'punched' onto tape. In a large system, the tables should be loaded through a VDT. Some systems require a programmer to toggle them into the system through switch manipulations on the computer front panel; these systems are a 'headache,' if the fonts ever change.

In some systems the face call out procedure does not automatically give the appropriate width tables to the typography programs.

Some typesetters do not use an electronic signal to indicate which fonts are loaded. The electronic system may perform all its work based on a given font. When in a working environment the typesetter operator loads a different font, erroneous results may be produced. All modern typesetters should be designed with this font-indicating feature.

If an Intelligent VDT (IVDT) which performs justification and hyphenation on the fly as keys are depressed is used, it should have an automatic feature to load the proper width tables as the fonts are required (even within a line). There are sometimes round-off errors if the typesetter operates with one set of width units and the typesetting computer utilizes another. The error caused by round-off should be investigated to determine if its size is unacceptable.

In the large systems it would be nice to be able to output the width tables on a line printer or have them set by the typesetter, and to be able to edit these files in the same manner that a normal text file is edited.

6. END OF TAKE CONSIDERATIONS

These considerations may seem trivial, but they can make the operation a lot easier if they are properly taken care of. If film is being exposed, proper end of take procedures can save a great deal of unnecessary cost. When the end of the take arrives at the typesetter, the typesetter should be told to advance the film/paper a desired distance and cut it. If it cannot automatically cut the film/paper, a light or indicator should alert the operator. When a new take is started the film/paper should be advanced the required margin amount.

If the film/paper runs out in the middle of a take, the computer system should be notified (hopefully automatically) and the take re-exposed either completely or from a desirable point within the take.

B. JUSTIFICATION

This section deals with justification, the process of aligning text to present a pleasing appearance. In some cases it is impossible to produce an attractive justified line without breaking a word. When this occurs, the machine must determine where to break the word, a process referred to as hyphenation.

Several definitions of words used to describe the justification process are given, followed by a narrative description. Lastly, a structured program flow graph is presented to show automatic computer justification.

1. DEFINITIONS

Justification. A process of aligning text to present a pleasing appearance. Text may be left justified (all left ends of lines even), right justified (all right line ends even), or left and right justified (all lines the same length and aligned). The condition where all right line ends are even is sometimes called flush right. The same applies for the term flush left.

Exception Word Dictionary. An ordered list of all known words, roots, prefixes, or suffixes which do not fit the rules of the hyphenation algorithm. The exception word dictionary will be small if the algorithm is efficient, large if the algorithm is simple.

Word Spacing. The space between words in a line of text. The amount of space can be varied to produce justified text.

Letter Spacing. Spaces inserted between the letters of a word to prevent word spacing from becoming excessive.

Hyphenation. In attempting to justify a line of text, it may be desirable to break a word. The process of determining where to break a word is called hyphenation.

Relative Units. Most impact printing devices allow the same width for all characters regardless of the space actually needed. In typography, only the space needed is allowed. The largest character in most type fonts is the capital M. The width of an M is divided into 18 equal units called relative units since their actual size will vary with the size of the type font. The width of each character is expressed as the number of 1/18 of an M which it occupies. Either relative or absolute width can be used in a hyphenation or justification algorithm.

2. GENERAL DESCRIPTION

As in all computer programs, the first step should be to write out what is expected of the program and how it will operate. An example for justification is as follows. A line of text is scanned character by character. If a line terminating command is encountered, the line is output as specified. If an indent-type command is encountered, its specifications are held to take effect when a new line begins.

Each character or text-type command is examined for its width value, which is accumulated into a running width-total. When this width-total becomes non-zero (i.e., when a character has been placed on the line), the total character (text) length for this line is computed, taking into account all waiting indent-type specifications.

As each character is placed on the line, the running line length width-total is compared with the measure length. If the character precedes a spaceband, the width-total is used as is; if the character precedes anything other than a spaceband, the width of one hyphen is added to the width-total for the purposes of the line length computation.

Up to this point, the running width-total has been computed using the maximum allowable width for spacebands, but a count has been kept of the number of spacebands encountered. When the width-total overflows the measure length while using the maximum spaceband value, the character which creates an overflow will mark the beginning of the range of text in which the line-break can occur. It is now possible to scan character by character, searching for a potential line-break within the justification range. The end of the range will be detected by changing the running width total at the start of the range to reflect an accumulated width using the minimum spaceband width (a simple matter since the spaceband count has been maintained). With the character scan using this minimum spaceband width, when the running width total again overflows the measure length, it will mark the end of the range in which a line-break must be found. In actual practice, an intermediate spaceband width is used until measured overflow, and then the maximum spaceband width is used to complete the scanning of the range. This has the effect of splitting the range at a point which reflects the use of this intermediate spaceband width. This is used to select, from among the possible line-breaks, the one which allows the closest possible approximation to the intermediate spaceband width. The selected line-break is the one that will result in a spaceband width whose value will lie close to the 'ideal spaceband width' earlier selected by the user. (If this latter qualification cannot be met in any given instance, it is temporarily ignored.)

Ideally, the intermediate spaceband width used for justifying each line should be a recency weighed average of the spaceband widths which has resulted from the justification of previous lines. This 'recency weighting' implies that the 'ideal' spaceband width will vary dynamically throughout the text. If the text, up to this point, has been such that the spacebands have been set wider than the user stated ideal, then the program will adjust its width slightly upward. This method for selecting one of the several possible line-breaks, tends to smooth out variations in spaceband width throughout a text and, additionally, attempts to adhere to the user's stated 'ideal'.

This method is first used to search among spacebands which could be used as line-breaks. If no spacebands are found within the entire range, hyphenation is attempted. The range is then scanned again to select one of the possible hyphenation line-breaks.

If this procedure still fails to provide a line-break, letterspacing is attempted. For purposes of letterspacing, a word is defined as a group of two or more alphabetic characters bounded by non-alphabetic characters (or end-of-line).

Letterspacing is performed on the first word in the line and an attempt is made to justify the line as previously described. If no line-break is found, letterspacing is performed on an additional word and justification is again tried. This process continues until no words remain to be letterspaced. In the unlikely event that all procedures fail to produce an acceptable line-break, an emergency action is taken. This involves displaying an error message to the user, and outputting a section of the unjustified text (in a shortened measure) to enable the routine to continue.

In the event that the line is allowed to remain ragged, the overall procedure changes somewhat. The entire line of text is treated as an acceptable range for a line-break. As described above, spaceband line-breaks are sought before hyphen line-breaks. Of course, no attempt is made to use anything but the ideal spaceband width.

3. DETERMINATION OF THE JUSTIFICATION ZONE

Determination of the range over which the line must be broken is shown on the next page in flow graph form. The structured program flow graph of the justification process is intended to describe, in sequence, the major steps which must be taken in order to produce justified copy.

1. If desired, an optimum rather than minimum value of space band width can be used. This optimum value can be dynamic to allow for a 'recency weighted' value to be used.
2. At the end of this flow graph, we have a range within which the line must be broken.

```
IF (last character was an indent character)
    THEN (add width of indent to running width total)
    ELSE (null)
DO UNTIL (exit flag is set)
    (get next character and put it in buffer)
    IF (character is a line terminating command)
        THEN (set exit flag)[1]
            (set space bands to intermediate width)
            (send buffered line)
            (clear running width total)
            (set line done flag)
        ELSE (add character width to running width total)
            IF (next character is a space band)
                THEN
                    IF (running width total> allowed line length)
                      THEN (set exit flag)
                      ELSE (null)
                ELSE
                    IF (width total + width hyphen ≥ allowed line length)
                      THEN (set exit flag)
                      ELSE (null)
(clear exit flag)[2]
```

---

[1] Use the largest value for spacebands at this point to define the start of the range in which the line can be broken.

[2] At this point, the fewest possible number of characters are in the line buffer. The widest spaceband width has been used up to this point to define the earliest possible point at which the line could be broken.

```
IF (line done flag is set)[3]
    THEN (null)
    ELSE (recompute running width total using minimum spaceband width)
        DO UNTIL (exit flag is set)
            IF (next character is a terminating command)
                THEN (get the character and put it in the buffer)
                     (set exit flag)
                     (send buffered line)
                     (clear running width total)
                     (set line done flag)
                ELSE
                     IF (next character is a hyphen or character after next is a
                        spaceband)
                         THEN
                              IF (character width + width total > line)
                                  THEN (set exit flag)
                                  ELSE (get character put into buffer)
                                  (add character width to width total)
                         ELSE
                              IF (character + hyphen + running > line)
                                  THEN (set exit flag)
                                  ELSE (get character put into buffer)
                                  (add character width to width total)
(clear exit flag)
IF (line done flag is set)[4]
    THEN (null)
    ELSE
```

---

[3] If the line has already been processed, then there is no need to determine where to break the line.

[4] A range is now determined within which the line must be broken.

4. LINE BREAK DETERMINATION

Once the Justification Zone is established, the possible line break points must be determined and the optimum point selected.

The reader should note that one of the cases mentioned in the following flow graph is that a hyphenation point was contained within the range. This statement makes reference to the process of searching for and identifying points at which hyphens could be inserted to allow for line breaks. This process is considered in the next section.

```
IF CASE (status of buffer)
    CASE (last character in buffer is a hyphen)
        (send entire buffer)
        (clear running width total)
    CASE (next character is a spaceband)
        (send entire buffer)
        (clear running width total)
        (get spaceband and discard it)
    CASE (there is a spaceband within the range)
        (send buffer to, but not including, the last spaceband)
        COMMENT: If optimum widths for spacebands were used initially, then this step would be to send the buffer to, but not including, the first spaceband within the range.
        (delete the spaceband)
        (compute new running width total for untransmitted characters)
    CASE (the last word, part of which is in the buffer, has a hyphenation point within the range)
        (insert a hyphen at the last point)
        COMMENT: If optimum widths for spacebands were used initially, the first hyphenation point within the range would be used.
        (send the buffer, including the inserted hyphen)
        (compute new running width total for untransmitted characters)
    CASE (letter spacing can bring a break within range)
        (insert letter spacing word by word until a line break is in range)
        (send buffer up to line break point)
        IF (break point was a spaceband)
            THEN (delete the spaceband)
            ELSE (null)
        (compute new running width total for untransmitted characters)
    CASE (all the above fail)
        (concatenate a hyphen)
        COMMENT: The method of determining the end of the range guarantees that there is room for a hyphen.
                (send the entire buffer including the hyphen)
                (clear the running width total)
```

1. This algorithm assumes that the text is to be justified left and right.
2. If the text is allowed to be ragged right or ragged left, then the following are implied:
    a. Only the optimum space band width is used.
    b. The beginning of a line is the start of the range for line breaks.
    c. Words which contain a hyphen will not be broken unless no spacebands can be found.
3. In the algorithm depicted above, there may be start and end of range marks and an 'ideal' mark. The line would then be broken at the space or (exiting) hyphen closest to this point.
4. This entire algorithm would be inside a loop which would be invoked as long as there were characters to be sent.

C. HYPHENATION

This section starts with a general description of the constraints which govern automatic hyphenation. Following this, two sets of rules are given, one for 'standard' hyphenation, and one for hyphenation considering word prefixes and suffixes. The 'standard' hyphenation rules include examples of words which are correctly hyphenated by the rules and some examples which are not. Any word which is not correctly hyphenated by application of the rules must be placed in the exception word dictionary.

1. HYPHENATION RULES

Since the first efforts to achieve automatic justification, the definition 'correct' hyphenation has presented a problem to the programmer. Every spoken language is governed by a different set of 'rules.' Unfortunately, it is difficult to define accurately what is 'correct' hyphenation. Often decisions are made subjectively and this makes the drawing up of a set of rules extremely difficult, because there are so many exceptions to the rules. Conventionally, a word reference book of national prominence is selected and is the foundation on which all further rules are based.

The English language is particularly difficult to hyphenate with only logical rules, because the exceptions to any rule can be considerable. The basic word structure in the English language is formed from the following elements:

1. Vowel. A vowel is usually the most prominent sound in syllable and is represented by a letter or letters. In the English language *a e i o u* and sometimes *y* are vowels.
2. Consonant. A consonant is the sound in a syllable, less prominent than a vowel. Consonants are represented by characters other than *a e i o u* or *y*.
3. Syllable. A syllable is a unit of the spoken language. It consists of one or more vowel sounds alone, preceded or succeeded by one or more consonant sounds; or a syllabic consonant alone, preceded or succeeded by one or more consonant sounds. A syllable is the next unit of speech above a phoneme.

Procedures in breaking words by hyphens begin by selecting the most appropriate dictionary or other work relating to word division. The hyphenating rules are based partially on syllabication. This method of dividing words into syllables and making the division point the hyphenation point, has many exceptions based on common usage and linguistic background. Even with one language, English, there is a fundamental difference between the two principal forms — American and British — for syllabication.

The following principles are generally accepted as applicable to the American and British rules:

1. Monosyllabic Words. Words which are pronounced as one syllable are not hyphenated.
2. Compound Words. Words which are formed by joining or compounding two or more simpler words can only be hyphenated at the concatenation points.
3. Prefix. A hyphen can be inserted between a prefix and the stem or main part of a word.
4. Suffix. A hyphen can be inserted between the stem of a word and the suffix.

After this the rules are peculiar to either the American or the British approach. Syllabication is achieved by pronunciation (phonetically) in the American approach, and by etymology in the British approach. An example of this is the following:

Etymologic (British)	**Phonetic (U.S.)**
magni-ficent	magnif-icent
signi-ficant	signif-icant

The British and American spelling for the same words often differ. A simple set of rules for hyphenating American usage is shown below. A hyphen may be inserted when the following conditions are met:

1. The word must have a least five characters.
2. Three characters or more of the hyphenated word must be carried over to the next line.
3. Two characters or more must remain on the line which contains the hyphenated word.
4. A hyphen can be inserted between two consecutive consonants when a consonant from Group 1 is followed by a consonant from Group 2.

Group 1 B C D F M N P R T V X Z
Group 2 B C D F J M N P S T V W Z

5. The letters K or H can be followed by a hyphen if followed by one of the Group 2 consonants excluding *N S T*.

For every set of rules there will be exceptions. Some words can be either verbs or nouns with two different hyphenations as shown below.

Noun	**Verb**
pres-ent (a gift)	pre-sent (to make a gift)
proj-ect (a task)	pro-ject (to throw forward)
rec-ord (a copy)	re-cord (to copy)

2. GENERAL DESCRIPTION

A written narrative or functional specification of what a program is to do should be the first phase in writing a computer program. A functional specification for a hyphenation program could be as given below:

General hyphenation programs will locate acceptable hyphenation points in English words which overflow the line length. Hyphenation will be attempted only after no acceptable line break can be found by adjusting the size of the inter-word spacing. A program should consist of three major parts — a suffix routine, a prefix routine, and a letter combination routine. Apart from the prefix and suffix routines, the program should have the following general considerations:

1. At least two letters must precede and follow the point of hyphenation.
2. A word must have two vowel groups separated by a consonant group before it can be hyphenated.
3. The word which causes the line length to overflow is the one which is scanned for possible hyphenation points. The scan is from the end of the word to the front. Initially, a word (for the justification routine) is all characters between spacebands, so the following would all be considered 'words' by the justification routine: (algorithms. computer, quickly! engines?)
4. The hyphenation routine must be discriminating and take the end point of a word to be the last character which is not punctuation, s, or 's.
   algorithm/s.
   computer/,
   quickly/!
   engine/s
   Mildred/'s
5. The justification routine defined a range in which a line could be broken. If a hyphen is placed by the rules but falls outside the 'justification possible' zone, then that 'unsuccessful' hyphen becomes the end of the word (actually the point at which the rules begin to be reapplied). At this point (preceding an 'unsuccessful' hyphen) the 'end of word' must be moved left of s, 's or es.
6. Any embedded tape feed or non-alphabetic character will cause rejection of the word.
7. The rules must be able to hyphenate numbers (such as $10,000) after commas, break at natural hyphens, etc.

Symbols used in specific rules:

V = vowel (a,e,i,o,u,y)
C = consonant
⋆ remaining letters not covered
⋆⋆ reject — restart rules
- hyphen insertion point

Specific program rules should now be written for the hyphenation routines (generally excluding prefixes and suffixes). These rules could typically be the following:

1. A word must have two vowel groups separated by a consonant group before it can be hyphenated (e.g., *caught* cannot be hyphenated).
2. All characters to the right of the punctuation mark, such as an apostrophe, cannot be hyphenated.
3. Provide for the following:
    - a) Check *s* endings and eliminate s, unless *-es, ies or ess;* treat *e* and *ie* as vowels.
    - b) Check for *e,* ignore ending for silent *e* or *ue* (e.g., league).
    - c) Check *ing,* then
      ling, then
      hyphen *-b, c, d, f, g, k, p, s, t, z, ling.*
    - d) If not *ling,* then check for *d-ding; tting* and *t-ting m-m; n-n; g-g; b-b; p-p; r-r;*
    - e) If not then - *ing.*
    - f) Check for *ed* ending and repeat (c) above; if not, then *d-ded; t-ted.*
    - g) Check for *er* ending and repeat for (c) and (d) above; if not then *-ter.*
    - h) Check for *y* ending and repeat (c) and (d) above:
      if not, and not *ly* then treat *y* as a vowel and continue.
    - i) After ending routines, continue seeking a vowel after encountering a vowel look for following consonant combinations.
        1. r: -br, cr, dr, fr, gr, pr, tr, str, wr
        2. h: -sh, th, ph, ch, wh, gh
        3. k: -ck
        4. p: -sp
        5. t: vowel s-t, consonant -st
        6. x: x-
        7. n: -kn, vowel n-
        8. v: iv-
        9. w: -tw
        10. -str
    - j) Check for (vowel) (consonant) (vowel) v-cv or c-cv (exceptions as above).
    - k) Check for naturally hyphenated word.
    - l) Minimum or 2 characters in front of hyphenation point and three characters in back.
4. Provide count of characters as you proceed.
5. Provide area for keeping count of character widths to right of hyphen point.
6. If numerals are encountered, no hyphenation of word is permissible.

3. LETTER COMBINATIONS FOR HYPHENATION

Word Letter	**Point of Hyphenation**	**Word Examples**
End of Word or Immediately Preceding Unsuccessful Hyphenation Attempt.		
G (called G rule)	b - b before ing	rub-bing
	d - d before ing	wed-ding
	g - g before ing	hug-ging
	m - m before ing	dim-ming
	n - n before ing	run-ning
	p - p before ing	tap-ping
	r - r before ing	pur-ring
	t - t before ing	pet-ting
	e - thing	some-thing
	y - thing	every-thing
	★th-ing	noth-ing
	ck - ling	chuck-ling
	★-kling	twin-kling
	- bling	gam-bling
	-cling	cy-cling
	-dling	han-dling
	-fling	ruf-fling
	-gling	snug-gling
	-pling	dum-pling
	-tling	rat-tling
	-zling	fiz-zling
	★- ing	suck-ing
	r - ling	snar-ling
	★★g apply program rules	hum-bug
	★★ng apply program rules	strong
End of Word Only		
D	d - d before ed	wed-ded
	t - t before ed	but-ted
	d - before ed	deed-ed
	t - before ed	haunt-ed
	ck-l before ed	tack-led
	- kl before ed	spar-kled
	- b before led	trem-bled
	- c before led	cy-cled

Note: ★ is any letter that is not shown previously. ★★ = reject – restart rules.

Word Letter	Point of Hyphenation	Word Examples
	- d before led	doo-dled
	- f before led	baf-fled
	- g before led	snug-gled
	- p before led	dim-pled
	- t before led	shut-tled
	- z before led	fiz-zled
	★★d apply program rules	sor-did
	★★ ed apply program rules	em-bedded
E	- ble	trem-ble
	- cle	bicy-cle
	- dle	doo-dle
	- fle	baf-fle
	- gle	snug-gle
	- ple	dim-ple
	- tle	rat-tle
	- zle	puz-zle
	- ckle	(do not hyphenate)
	★ - kle	spar-kle
	★ - b	im-bibe
R	b - ber	rub-ber
	d - der	rud-der
	g - ger	dig-ger
	m-mer	ham-mer
	n -ner	run-ner
	p - per	strip-per
	r -rer	stir-rer
	t - ter	bet-ter
	Vs - ter	blis-ter
	C - ster	gang-ster
	★★ -ler apply program rules	tumb-ler
Y	- bly	nim-bly
	g - gly	wig-gly
	★gly treat same as ing rules for end of word or immediately preceding unsuccessful hyphenation attempt	
	b - bly	gob-bly
	d - dly	cod-dly exception odd-ly

Word Letter	**Point of Hyphenation**	**Word Examples**
	g - gly	wig-gly
	p - ply	sup-ply
	★ - rly	bur-rly
	★★ - ly	sub-se-quent-ly
	Not at End of Words	
H	- ch	dis-charge teach-er
	- ph	tele-phone
	- sh	ko-sher, re-shape etc. (exception self-ish-ness)
	- wh	no-where
	gh -	through-out (exception egg-head)
	th -	heath-er (exception hea-then)
	★ - h	in-her-it
K	ck -	quick-est
	★ -k	ho-kum
L	- cl	un-clean
	- fl	re-flex
	- pl	no-place
	★ - l	al-low-able
N	Vn -	pan-cake
	★ - n	beat-nik
P	dis - p	dis-place
	mis - p	mis-place mis-print
	V (except e) s - p	dis-patch (exception: rasp-berry)
	e - sp	re-spect (exception: es-prit-de-corps)
	★ - p	re-prove (exception: rep-tile)
R	V or Cr -	mar-riage
	Vs-tr	as-tro-labe (exception: anti-strike)
	C-str	wild-strike, up-stream
	ght - r	night-raid
	★ - tr	ni-trate (exception: out-run)
	★ - r	non-resident

Word Letter	Point of Hyphenation	Word Examples
S	dis -	in-dis-crete
	mis -	mis-chief (exception dismiss-al)
	- cis	con-cise
	★ - is	cher-ish
	★ - s	neces-sitate (exception mus-cles)
T	Vs-t	inves-ti-gate
		exception in-tern-ists
	C-st	in-struct
	ght -	thought-ful
	★ - t	rut-ting
W	- Vw (except y)	play-write (exception: one-way)
	- tw	inter-twine
	★ - w	press-work
X	x -	ex-lax
Other letters	C - b	hard-ball (exception: hab-itant)
	- Vb	fri-able
	C - c	gun-cotton
	- Vc	gyn-ecology
	C - d	work-day (exception: third-class)
	- Vd	rap-id (exception: ra-pid-ity)
	C - f	rain-fall
	- Vf	rar-efaction
	C - g	stran-gle
	- Vg	strat-agem
	C - j	in-jury
	V - j	ma-jor
	C - m	touch-mark
	- Vm	min-im (exception: mi-mesis)
	C - n	mag-nate
	- Vn	pre-sent (exception: pro-cre-ant)
		exception pro-nounced
	C - s	seal-skin, scrim-shaw
	- Vs	maj-esty
	C - Vs	life-saving
	V - Vs	what-so-ever
		recre-ative
	C - z	zig-zag

Word Letter	Point of Hyphenation	Word Examples
	-Vz	ur-ban-ize (exception: woo-zy)
	z - V	wiz-ard, whiz-er

★★ — A,E,I,O,U,Y apply program rules

4. STRUCTURED PROGRAM FLOW GRAPHS — LEVEL ONE

The following is a structured program flow graph of the previously described hyphenation routine. One advantage of the flow graph method of presenting algorithms is that it allows the major steps to be presented in sequence (Level I) without getting too concerned with details. Where greater detail is desired, the reader should consult the Level II flow graph for an expansion of the step which is of interest. In some cases, the steps of Level II are explained on Level III, and so forth.

We now present the sequenced steps which are required to implement the hyphenation described previously. Level I gives the overview; with greater detail of some steps given in Level II. Higher level numbers represent greater expansion and coverage of details.

```
IF (word has less than 4 characters)
│       THEN (return from hyphenation routine)
│       ELSE
│               IF (word does not have two separate vowel groups)
│               │       THEN (return from hyphenation routine)
↓               ↓       ELSE (null)
(set end of word pointer by applying the end of word rule)
(set end of word flag)
(clear all other flags)
```

(Flow graph continued on overleaf.)

```
DO UNTIL (successful hyphen or reached start of word)
    IF CASE (status of flag)
        CASE (unsuccessful hyphen)
            IF (next character is a G)
                THEN (apply the G rules)
                ELSE (null)
        CASE (end of word)
            IF CASE (next character)
                CASE (D)
                    (apply the D rules)
                CASE (E)
                    (apply the E rules)
                CASE (G)
                    (apply the G rule)
                CASE (R)
                    (apply the R end of word rules)
                CASE (Y)
                    (apply the Y rules)
                CASE (all others)
                    (set no hyphen flag)
        CASE (not end of word)
            IF CASE (next character)
                CASE (H)
                    (apply the H rules)
                CASE (K)
                    (apply the K rules)
                CASE (L)
                    (apply the L rules)
                CASE (N)
                    (apply the N rules)
                CASE (P)
                    (apply the P rules)
                CASE (R)
                    (apply the R mid-word rules)
                CASE (S)
                    (apply the S rules)
                CASE (T)
                    (apply the T rules)
                CASE (X)
                    (put hyphen at the pointer and set hyphen found flag)
                CASE (A, E, I, O, U, Y)
                    (set no hyphen flag)
                CASE (B, C, D, F, G, J, M, Q, V, W, Z)
                    (place hyphen to left of character)
```

```
                        (set hyphen found flag)
    IF (hyphen found flag set)
        THEN
            IF (more than one letter to start of word and
               more than one letter from end)
                THEN
                    IF (hyphen falls within justification possible range)
                        THEN (set successful hyphen flag)
                        ELSE (set unsuccessful hyphen flag)
                             (move pointer to hyphen)
            COMMENT: At this point, an additional check can be made to deter-
            mine if the hyphen is to the left of the justification possible zone. If so,
            apply the emergency procedure; either: (1) allow a short line or, (2)
            hyphenate the word in spite of the rules. If not making such a check,
            then
                (clear hyphen found flag)
                ELSE
                    (set start of word flag)
        ELSE (clear end of word flag)
            (move pointer one character left)
(return from hyphenation routine)
```

5. STRUCTURED PROGRAM FLOW GRAPH — LEVEL TWO

The (set end of word flag) step is done as follows:

```
DO WHILE (the last character of the word is punctuation)
    (move end of word pointer left one character)
    COMMENT: For hyphenation, do not consider punctuation marks.
IF (last character is S)
    THEN
        IF CASE (next character)
            CASE (next character is an apostrophe)
                (move end of word pointer to left of apostrophe)
            CASE (next character is not - s)
                (move end of word pointer to left of s)
            COMMENT: The implication is that words ending in double s will be
            considered in whole.
    ELSE (null)
```

The (apply the G rules) step is expanded below.

```
IF (2nd character left of pointer is N and 3rd is I)
    THEN (apply the ING rules)
    ELSE (null)
```

CASE (D)

The (apply D rules) step is expanded below.

```
IF (next to last letter is E)
    THEN
        IF CASE (second to last letter)
            CASE (D or T)
                IF (3rd to last letter is same as 2nd to last)
                    THEN (hyphenate between 3rd and 2nd to last
                         character)
                    ELSE (hyphenate before next to last character)
                (set hyphen placed flag)
            CASE (L)
                IF (3rd to last letter is B, C, D, F, G, P, T, Z)
                    THEN (hyphenate before 3rd to last letter)
                    ELSE
                        IF (3rd to last letter is K)
                            THEN
                                IF CASE (4th from last letter)
                                    CASE (C)
                                        (hyphenate between 3rd and
                                         2nd from last)
                                        (set hyphen flag)
                                    CASE (R)
                                        (hyphenate between 4th and
                                         3rd from last)
                                        (set hyphen flag)
                        ELSE    (null)
    ELSE (null)
```

CASE (E)

The step (apply the E rules) is expanded below.

```
IF (next to last letter is L)
    THEN
        IF (2nd from last letter is B, C, D, F, G, P, T, Z)
            THEN (hyphenate before 2nd from last letter)
                 (set hyphen placed flag)
            ELSE
                IF (3rd from last letter K
                    THEN
                        IF CASE (4th from last letter)
                            CASE (C)
                                (hyphenate before 2nd from last letter)
                                (set hyphen placed flag)
                            CASE (R)
                                (hyphenate before 3rd from last letter)
                                (set hyphen placed flag)
                    ELSE        (null)
    ELSE        (null)
```

CASE (R)

The (apply the R rule) is expanded below.

```
IF (next to last letter is E)
    THEN
        IF (2nd from last letter is B, D, G, M, N, P, R, T)
            THEN
                IF (3rd from last letter is same as 2nd from last letter)
                    THEN (hyphenate before 2nd from last letter)
                         (set hyphen found flag)
                    ELSE (null)
            ELSE
                IF (2nd from last letter is T)
                    THEN
                        IF (3rd from last letter is a vowel)
                            THEN (hyphenate before 2nd from last letter)
                            ELSE (hyphenate before 3rd from last)
                    ELSE (null)
    ELSE (null)
```

CASE (Y)

The (apply the Y rule) is expanded below.

```
IF (next to last letter is L)
    THEN
        IF CASE (2nd from last letter)
            CASE (B)
                (place hyphen before second from last letter)
                (set hyphen found flag)
            CASE (D, M, N, P, R, T)
                If (3rd from last letter is same as 2nd from last letter)
                THEN (place hyphen before 2nd from last letter)
                    (set hyphen placed flag)
                ELSE (null)
                CASE (G)
                    IF (3rd from last letter is also G)
                        THEN (place hyphen before 2nd from last
                              letter)
                              (set hyphen placed flag)
                        ELSE
                            IF (4th from last letter is N and 5th
                                from last letter is I)
                                THEN (apply ING rules)
                                ELSE (null)
                                COMMENT: ING rules will be
                                a subroutine
    ELSE (hyphenate before next to last letter)
        (set hyphen found flag)
```

CASE (H)

The (apply the H rules) step is expanded below.

```
IF CASE (next letter)
    CASE (C, P, S, or W)
        (place a hyphen between the 3rd and 2nd characters)
    CASE (G or T)
        (place a hyphen to the right of the 1st letter)
    CASE (all other characters)
        (place a hyphen between the 2nd and 1st characters)
(set hyphen found flag)
```

```
CASE (K)
```

The (apply the K rules) step is expanded below.

```
IF (the next character is a C)
        THEN (put the hyphen to the right of the 1st character)
        ELSE (put the hyphen between the 2nd and 1st characters)
(set hyphen found flag)
```

```
CASE (L)
```

The (apply the L rules) step is expanded below.

```
IF (next character is C, F, or P)
        THEN (place hyphen between 3rd and 2nd characters)
        ELSE (place hyphen between 2nd and 1st characters)
(set hyphen found flag)
```

```
CASE (N)
```

The (apply the N rules) step is expanded below.

```
IF (next character is a vowel)
        THEN (place the hyphen to right of the 1st character)
        ELSE (place the hyphen between 2nd and 1st character)
(set hyphen found flag)
```

```
CASE (P)
```

The (apply the P rules) step is expanded below.

```
IF (next character is S)
        THEN
                IF (next two characters are I, D or I, M)
                        THEN (place hyphens before 4th character and between 2nd and 1st
                                 character)
                        ELSE (place hyphen between 3rd and 2nd characters)
        ELSE (place hyphen between 2nd and 1st characters)
(set hyphen found flag)
```

```
CASE (R)
```

The (apply the R rules) step is expanded below.

```
IF CASE (next character)
    CASE (vowel)
        (place hyphen to right of 1st character)
    CASE (T)
        IF (3rd character from pointer is S)
            THEN
                IF (4th character is vowel)
                    THEN (place hyphen between 3rd and 2nd characters)
                    ELSE (place hyphen between 4th and 3rd characters)
            ELSE
                IF (3rd character is an H, 4th is a G)
                    THEN (place hyphen between 2nd and 1st characters)
                    ELSE (place hyphen between 3rd and 2nd characters)
    CASE (C)
        IF (3rd letter from pointer is S)
            THEN
                IF (next two characters are I,D or I,M)
                    THEN (put hyphen to left of 5th character and between
                            3rd and 2nd)
                    ELSE (put hyphen between 4th and 3rd characters)
            ELSE (put hyphen between 3rd and 2nd characters)
    CASE (B, D, G, F, or P)
        (put hyphen before 2nd character)
    CASE (all others)
        (put hyphen between 2nd and 1st characters)
(set hyphen found flag)
```

```
CASE (S)
```

The (apply the S rules) is detailed below.

```
IF (next two characters are I,D or I,M)
    THEN (place hyphen to left of 3rd character and to right of 1st character)
    ELSE (place hyphen between 2nd and 1st characters)
(set hyphen placed flag)
```

CASE (T)

The (apply the T rules) is detailed below.

```
IF (next character is an S)
        THEN
                IF (3rd character is a vowel)
                        THEN (place hyphen between 2nd and 1st characters)
                        ELSE (place hyphen between 3rd and 2nd characters)
        ELSE
                IF (2nd character is an H)
                        THEN
                                IF (3rd character is a G)
                                        THEN (place hyphen at the pointer)
                                        ELSE (place hyphen between 2nd and 1st characters)
                        ELSE (place hyphen between 2nd and 1st characters)
(set hyphen found flag)
```

6. STRUCTURED PROGRAM FLOW GRAPH — LEVEL THREE

The subroutine (apply the ING rules) is implemented to do the following:

```
IF CASE (4th character to left of pointer)
        CASE (B, D, G, M, N, P, R, T)
                IF (5th character is same as 4th)
                        THEN (place hyphen between 5th and 4th character)
                                (set hyphen found flag)
                        ELSE (null)
        CASE (L)
                IF CASE (5th character left of pointer)
                        CASE (K)
                                IF (6th character is C)
                                        THEN (place hyphen between 5th and 4th characters)
                                        ELSE (place hyphen between 6th and 5th characters)
                                (set hyphen found flag)
                        CASE (B, C, D, F, G, P, T, Z)
                                (place hyphen between 6th and 5th characters)
                                (set hyphen found flag)
                        CASE (all others)
                                (place hyphen between 4th and 3rd characters
                                (set hyphen found flag)
        CASE (all others)
                (place hyphen between 4th and 3rd characters)
                (set hyphen found flag)
(return)
```

D. IMPLEMENTATION OF TYPOGRAPHICAL COMMANDS

In order for a computer driven typesetting system to be complete, a means must be provided to allow special functions to be processed to satisfy the requirements of good graphic quality in page layout. Such functions as tab commands, run-arounds, centering of copy on a line, and leadering are examples of this. In addition, the command repertoire should include the ability to change type size, type face (say from Roman to Italic), column width, vertical leading, etc.

Presented below are ways in which several representative functions could be implemented.

A. QUAD RIGHT

The quad right function causes all copy to be moved flush with the right margin. All spacebands are set at minimum width and fixed spacing is inserted at the left to fill out the line.

This algorithm is assumed to be part of a justification program. At the time this routine is activated, a quad right has been found and the text for this line is already in a justification buffer. Spacebands were set at maximum until the line was filled; these were reduced to minimum to establish the range of the 'justification possible' zone. The quad right could occur with spacebands set at either value; that is, at any point within the justification buffer.

```
(calculate width of current text with minimum spaceband width)
(compute amount of space required to fill the line)
(output required space)
(output text from justification buffer)
```

B. TAB AROUND

The Tab Around function can occur anywhere on a line except at the first character. The function of a Tab Around is to center the text it follows on a pre-set point (equal amounts of the word on either side of the tab position).

The following description assumes that the position of the tab has been set and that the text will fit on the line. (This is a valid assumption. If the text did not fit, then the hyphenation process would have broken the word already). It is also assumed that the last character in the justification buffer is the Tab Around command character.

A structured flow graph for Tab Around is as follows:

```
DO UNTIL (Start of buffer or another Tab type command)
        (move Start pointer left one character)
        (set End pointer on last character of text)
        (set all spacebands between Start and End at minimum width)
        (Text Width: = width of text between Start and End, inclusive)
        IF (source text is already on this line)
                THEN (space = difference between tab position and end of existing text)
                ELSE (space = difference between start of buffer and Tab position)
                        IF (Text Width) is greater than Space)
                                THEN (fill existing line with spaces and output it)
                                (Space = difference between start of buffer and Tab position)
                                ELSE (null)
                                (Calculate difference between Space and (Text Width)
                                (Output enough space to fill this difference)
                                (Output the text string between Start and End, inclusive)
                                (Done with the Tab Around)
```

NOTE: If there is not enough room between existing text (already on the line) and the Tab position for half of the current text, the existing text will be set as is (the line filled out with spaces) and the current text set on the next line, around the Tab position.

C. INSERT LEADER ON SPLIT QUAD.

Assumptions:

1. Command is placed in text at the point where the leaders are supposed to be inserted.
2. The line is terminated by a justify command or some other form of line ending code.
3. There may be only one ‘insert leader’ command in a line of text.

Limitations:

1. If a full line occurs prior to finding the ‘insert leader’ command, it will be justified as per normal processing; that is, this routine is only invoked when an ‘insert leader’ command is encountered.
2. If the line is full before the line end command is found, the whole line, from the ‘insert leader’ command, will be filled out with leadering.

Implementation:

The leader dots must be aligned from line to line. One way to accomplish this is relatively simple. The leader character (either em leader or en leader) is a certain width (in RU). If an entire line was set using leaders with any extra space on the right, then each leader dot would have a specific position. When the text to the left of the ‘insert leader’ command is found, and bands set to minimum (or optimum) width, the width is known. The amount remaining after dividing the text width by the width of a leader character is of fixed space that must be added to the text before setting leader characters. The number of leader characters to set is found by dividing the unused width (line length — text on left +

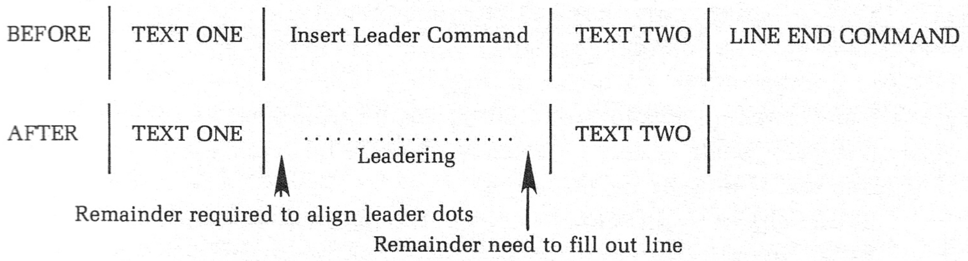
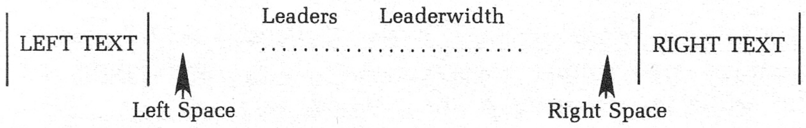

BEFORE
TEXT ONE
Insert Leader Command
TEXT TWO
LINE END COMMAND
AFTER
TEXT ONE
....
Leadering
TEXT TWO
Remainder required to align leader dots
Remainder need to fill out line

Figure 41 Insertion of Aligned Leaders

remainder + text on right) by the width of the leader character. The remainder is the amount of white space (fixed spacing) which must be inserted between the leaders and the rest of the text on the line.

A structured flow graph for Insert Leader with Split Quad is as follows:

```
(send all text accumulated so far)
(send enough fixed space to align leader dots)
(set characters until finding line end or overflowing line)
IF (line not overflowed)
|     THEN
|           (set spacebands to minimum)
|           (set leaders to fill space, leaving room for rest of text)
|           (send fixed space to fill between leaders and rest of text)
|           (send rest of text)
|     ELSE
|          (fill line out with leader dots)
|          (send fixed space to fill between leader dots and end of line)
v          (unsent text gets moved to the start of the buffer)
(done)
```


Leaders
Leaderwidth
LEFT TEXT
....
RIGHT TEXT
Left Space
Right Space

Linelength = length, in RU, of line being set
Lefttext = width of text between start of line and insert leader command with minimum wi spacebands
Leftspace = width of space to be inserted between text and the leadering to align the dots
Rightspace = width of space to be inserted between leaders and remaining text
Righttext = width of text to be inserted between leaders and end of line
Leaderwidth = width of one leader character
Leftspace = 0 if remainder of (Lefttext ÷ Leaderwidth) = 0
Leaderwidth - remainder of (lefttext ÷ leaderwidth)
Leaders = integer quotient of
(Linelength - Lefttext - Leftspace - Righttext) ÷ Leaderwidth Rightspace =
Linelength - (Lefttext + Leftspace + Leaders Leaderwidth + Righttext)

Figure 42. Leader Routine

D. INDENT HANGING (LEFT)

Assumptions:

Command is placed immediately following an end of paragraph code (before any text).

Implementation:

The normal action during justification of a paragraph is to insert space on the first line of text and set everything else flush left. For the indent hanging paragraph, the reverse is true; that is, the first line is set flush left and all other lines are indented.

Encountering an indent hanging command merely causes a flag to be set indicating that such a mode of operation is now in effect. It will remain in effect until revoked (either by another command or by an end of paragraph command, as desired).

The end paragraph command, among other things, sets a flag indicating that an end of paragraph has just been encountered. This flag is the 'Start Of New Paragraph' flag.

At the end of a paragraph: the justification buffer is empty and the program does not know whether there is any more text to process. It is at this point that the following structured flow graph starts.

```
DO UNTIL (there are no more characters)
    (get character)
    IF (character is a command)
        THEN (call routine to process command)
        ELSE
        IF (start of a paragraph)
            THEN
                IF (indent hanging flag is set)
                │   THEN (null)
                ↓   ELSE (put insert space in buffer)
            (clear start of paragraph flag)
            ELSE
```

The other place where some action must occur is after a justified line has been output but before any movement of characters to the left (start) of the buffer has occurred.

```
(next pointer gets value of start pointer)
IF (indent hanging flag is set)
│   THEN (insert required space at next pointer and move next pointer to the right)
↓   ELSE (null)
(move any untransmitted text to next pointer)
```

If the justification buffer is implemented as a circular buffer, then the above would need to be changed as follows:

```
(move the start pointer to the end of the portion which has been sent)
IF (indent hanging flag is set)
|       THEN (back up the start pointer one character and insert the indent space)
↓       ELSE (null)
(continue with the justification)
```

E. PREFIX AND SUFFIX CONSIDERATIONS IN HYPHENATION

Rules involving letter combinations will not yield good hyphenation by themselves. Prefixes and suffixes should be considered before the letter combination rules are applied in order to achieve good hyphenation. If program word storage capacity is limited, it may be necessary to utilize the letter combination rules by themselves. If a great deal of storage space is available, an Exception Word Dictionary can be added, which will considerably improve hyphenation over that obtained by (1) rules or (2) prefixes and suffixes with rules.

The beginnings of all words which occupy the justification zone should be examined for prefixes. The ends of all words occupying the justification zone should be examined for suffixes. A hyphen can be placed between the body of the word and a prefix or a suffix. However, some authorities indicate that this is the least preferred position for a hyphen if there are other hyphenation points in the word.

It is not always possible to determine whether a combination of letters is acting as a suffix or as part of a word. For example, the letters *ac* are a prefix in *acquire* and are part of the word *achieved*. The following table lists some letter combinations used as prefixes and gives some general rules about hyphenation. There are exceptions to every rule.

ab no hyphen if followed by: *a* or *b*
hyphen if followed by: *n* or *s*
ac no hyphen if followed by: *a*, *e*, *h*, *i*, *o* or *r*
hyphen if followed by: *c*, *k*, *q* or *t*
ad no hyphen if followed by: *a*, *e*, *o* or *s*
hyphen if followed by: *d*, *h*, *j*, *m* or *v*
af no hyphen if followed by: all letters
hyphen if followed by: *f* or *t*
al no hyphen if followed by: *a*, *i*, *o* or *x*
hyphen if followed by: *e*, *g*, *n*, *s* or *t*
ap no hyphen if followed by: *a*, *i*, *o* or *r*
hyphen if followed by: *p* or *t*
ar no hyphen if followed by: *a*, *e*, *i*, *m* or *o*
hyphen if followed by: *b*, *c*, *g*, *r* or *t*
as no hyphen if followed by: *a*, *h*, *i* or *k*
hyphen if followed by: *b*, *c*, *p* or *s*
at no hyphen if followed by: *e*, *h* or *l*
hyphen if followed by: *m* or *t*

au no hyphen if followed by: *c*, g, *n* or x
hyphen if followed by: *d* or *t*
de no hyphen if followed by: *e*.
hyphen if followed by: *c* (not *co*), *d*, *f*, *l* (not *le*), *m* (not *mo*), *o*, *p*, *r*, *s* (not *si*), *t*, or *v*

The intent is not to give a rigorous treatment of hyphenation in this *Guide*. The prefix hyphenation list will be terminated here.

The following are affixes which are commonly encountered:

Table Five. Commonly Encountered English Language Prefixes

AB
AC
AD
AF
AL
AN
AR
AS
AT
BE
DE
EC
EX
EM
EN
EP
ES
IM

IN
OB
OC
ON
RE
UN
UP

COL
CON
COR
DIA
DIS
DYS
EPI
MAL
MIS
MON

NON
NOW
OUT
PAN
PAR
PER
SUB
SUG
SUR
SYN
TRI
CIR
ANY
HOW
MAN

AMBI
ANTI

EVER
CATA
CATH
FORE
HEMI
HOMO
HYPO
OVER
PARA
PERI
POLY
POST
PROS
PROT
SEMI
SOME
WITH
REAL

WHAT
ENTR

HYPER
INTER
INTRO
MULTI
PROTO
RETRO
SUPER
SUPRA
THERE
TRANS
ULTRA
UNDER
ORTHO
EVERY
NEVER

Table Six. Commonly Encountered English Language Suffixes

AC
IE
LY
OM
OR
TY
UE

ADE
ANT
AIR
ARY
ASM

OUR
BLE
CLE
DLE
ERY
EST
FUL
ICS
ING
ION
IOR
IST
ITY

HOW
OGY
MAN
OUS
PLE
POD
TRY
THY
TLE
TOR
ULE
URE
VAL

CULE
DENT
EREL
ETTE
EVER
GRAM
HEAD
AIRE
ANCE
ANCY
BODY
CENT
CIDE

CISE
HOOD
ICAL
IOUR
IOUS
IQUE
LAND
LENT
LESS
LONG
LOUS
MENT
MOST

Table Six. Commonly Encountered English Language Suffixes (Continued)

NESS
OPHY
RIST
ROOM
SENT
HIP
SION
SOME

TIVE
TION
TORY
TURE
VERT
WARD
WAYS
WHAT

WISE

ASTER
CEOUS
CIOUS
ESQUE
GRAPH
ISTIC

LENCE
LOGUE
METER
NEOUS
OGIST
PHONE
RAPHY
SCOPE

SCOPY
THING
TRACT
WARDS

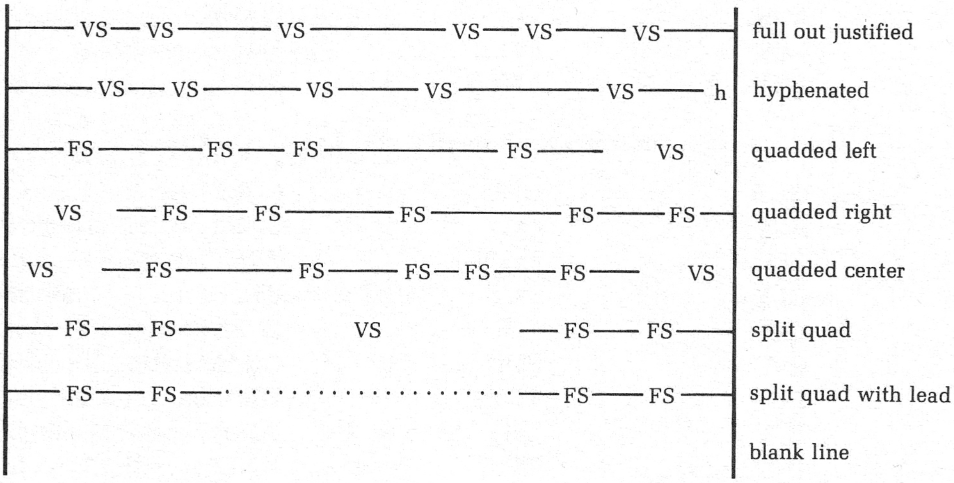
F. A PROGRAMMING VIEW OF TYPOGRAPHY

Before a wide spectrum of programmers can contribute to a particular discipline (such as typesetting) the requirements of that discipline must be systematically reduced to an easy to understand form. This form should show the basic program elements and the interrelationship of the elements.

A study of typesetting will reveal that there are only eight different types of lines that can be set in type. These are justified, hyphenated and justified, quadded left, quadded right, quadded center, split quad, split quad with leaders (dots symbols, etc.), and blank lines. These are shown in Figure 43, Basic Types of Lines.

If routines are written which can handle these eight different types of lines, they need to be able to accommodate three basic different horizontal parameters:

1. Element Width


—VS— VS—— VS—— VS— VS—— VS——
full out justified
——VS— VS—— VS—— VS—— VS—— h
hyphenated
—FS—— FS— FS—— FS—— VS
quadded left
VS —FS— FS—— FS—— FS—— FS—
quadded right
VS —FS—— FS—— FS— FS—— FS—— VS
quadded center
—FS— FS— VS —FS— FS—
split quad
—FS— FS—· —FS— FS—
split quad with lead
blank line

VS = Variable or calculated space; usually a high and low limit is specified. Program calculations determine this value.
FS = Fixed space or a value of space that is defined to be a range of VS or predetermined values to be used by program.

Figure 43. Basic Types of Line

2. Different Spacing
3. Different Effective Measures

The width, spacing, and different effective measures can be modified as shown in Figure 44, Typographic Function relationships.

If the eight different types of lines can be performed for the three basic horizontal parameters the horizontal position of most typographic configurations can be determined.

Table Seven, Basic Routine Relationship to Typographic Function, illustrates this fact in a different way.

The next item of concern is the vertical position. The vertical spaces are determined by the parameters as shown in Figure 44.

If the programs are written in table driven fashion, they can be primarily typesetter independent. The programs must present the data to the typesetter with the proper coding and units of measurement.

The programs must be reentrant table driven and modular in fashion to be the most useful in a real time system. The programs should have the following additional capabilities. The ability to:

a. store an instruction for future execution
b. store the result
c. fetch the previous result
d. mark a given horizontal and vertical point
e. return to a marked point

	Tabular	Indent	Run Arounds	Skew	Ragging	Overset	Full Out	Combinations Within Lines
Basic Routines	Sub divide measure	Change line length at selected or calculated points or blocks in text.	Line length changes at calculated points or blocks in text	Line length changes at each line				
Justify Normal								
Justify	Hyphenated							
Quad Left	Tab Left				Ragged Right			
Quad Right	Tab Right				Ragged Left			
Quad Center	Tab Center				Ragged Center			
Quad Split	Tab Around (Next Tab)				Ragged Middle			

Table Seven. Basic Routine Relationship To Typographic Functions.

This view of typography is not intended to be absolutely rigorous, but it is intended to outline program architectural needs and requirements, and to wipe away the 'black magic' which is ascribed to typography programming.

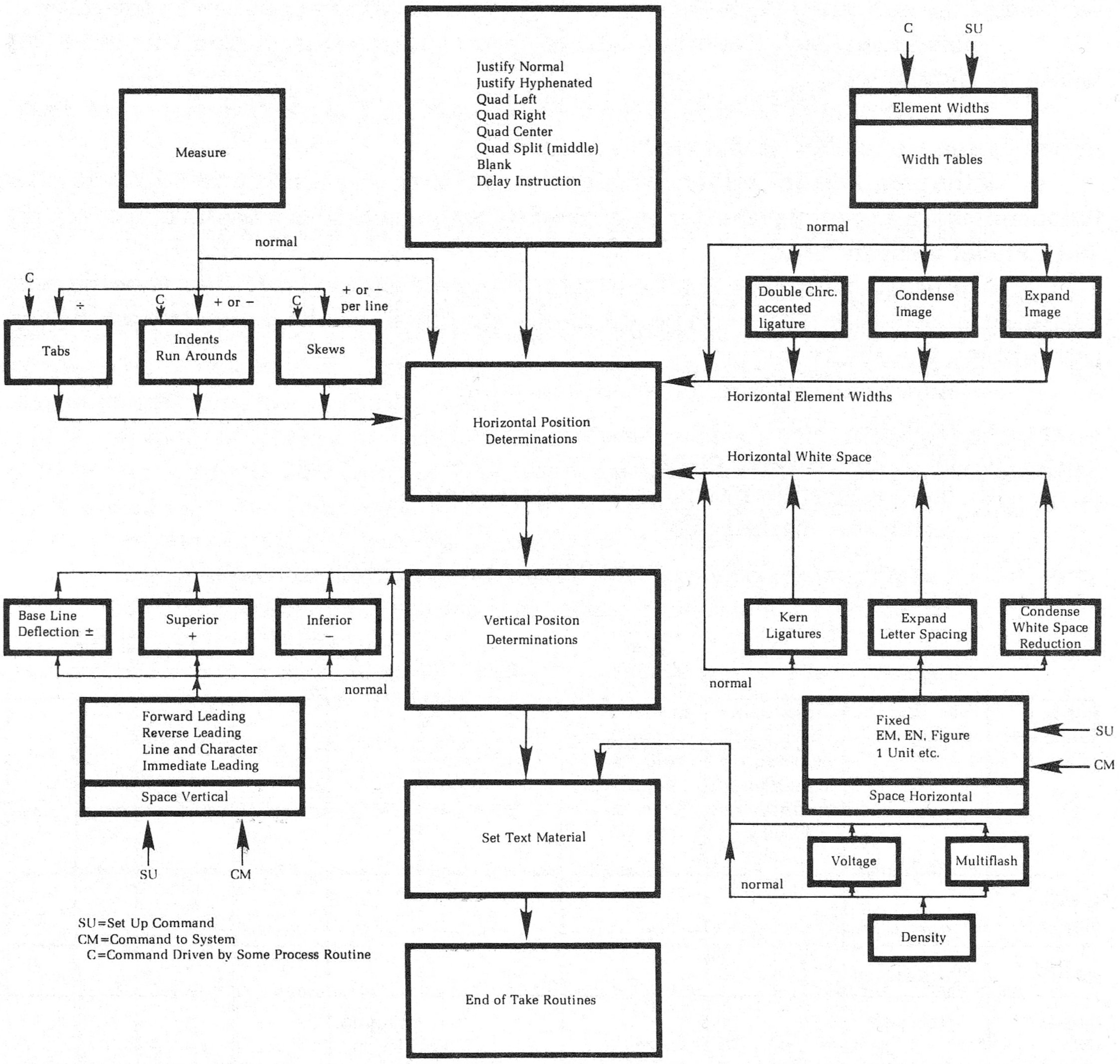

Measure
normal
C
÷
C
+ or −
C
+ or −
per line
Tabs
Indents
Run Arounds
Skews
Justify Normal
Justify Hyphenated
Quad Left
Quad Right
Quad Center
Quad Split (middle)
Blank
Delay Instruction
C
SU
Element Widths
Width Tables
normal
Double Chrc.
accented
ligature
Condense
Image
Expand
Image
Horizontal Element Widths
Horizontal Position
Determinations
Horizontal White Space
Base Line
Deflection ±
Superior
+
Inferior
−
normal
Vertical Positon
Determinations
Kern
Ligatures
Expand
Letter Spacing
Condense
White Space
Reduction
normal
Forward Leading
Reverse Leading
Line and Character
Immediate Leading
Space Vertical
SU
CM
Fixed
EM, EN, Figure
1 Unit etc.
Space Horizontal
SU
CM
Set Text Material
Voltage
Multiflash
normal
Density
End of Take Routines
SU=Set Up Command
CM=Command to System
C=Command Driven by Some Process Routine

Figure 44. Typographic Function Relationships

CHAPTER SIX

TYPESETTING

A. INTRODUCTION

Until recently there was no systematic way of viewing the ongoing technical progress of the evolutionary typesetting development. A 'Generation' classification, has been developed which successfully creates a rational subdivision of machines into classes. The classifications are:

1. *First Generation.* Machines evolved from their hot metal ancestors but adapted to the photographic process.
2. *Second Generation.* Machines not evolved from previous concepts embodied in hot metal machines but based on the new technology of setting type from photographic masters.
3. *Third Generation.* Machines designed to work in conjunction with computers at high speed (greater than 100 characters per second) and expose the character image via a CRT.

These classifications that originally served well have now been made indistinct by the newer technological developments. Even the simplest device, let alone a typesetter, may now include a capable computer. The continuing development of machines has intermixed technology borne over several 'generations'. The consequences of this are less distinct lines of definition between machines and no relationship between the term 'generation' and the point in time of evolution. The more recent development of scanning techniques for composing further complicates the classification issue. Therefore, for easier reference in this work, the classification of a machine will be based on the techniques used to store a master character and to generate the character for recording on the photographic output medium. The classification deliberately avoids all intervening and subsequent processes because these processes are still, in many cases, in a state of flux and are basically secondary (compared to the two principles referred to, in terms of classification, not economics). The three new classifications are:

Photo/Optic (Photographical/Optical)
Photo/Scan (Photographic/Scanning)
Digital/Scan (Digital/Scanning)

No inference to the chronology or the place in history can be made from the order of the new classifications; the order is for convenience's sake only.

The general principles of the photographic and optical techniques used in typesetters are fairly well known; considerable literature exists on the subject. Less has been written and less is generally known about scanning techniques for typesetting. The following information points out some of the issues to be considered when investigating a scanning type of system.

The scanning systems listed below generate lines or dots and other methods of creating signs (characters) on a film medium:

1. Cathode ray tube
2. Revolving drum and fixed light source
3. Fixed flat bed and moving light source

Cathode ray tube (CRT) (similar to home TV tube) phototypesetters were the first line or dot generating systems. The characters were stored digitally and 'set' on the CRT. The setting consists of driving the electron beam strike area (spot) across the selected area of the tube where the character is to be positioned. The spot is turned on and off, and the light generated on the phosphor coating on the inside of the face of the tube passes through the glass tube face onto a photographic film or paper. The CRT was selected to be the light source and the principal method of 'escapement'. The light can be generated at any point on the face of the CRT by positioning and turning on the (electron beam) spot. The positioning of the spot, and hence escapement, is extremely fast and is an inherent virtue of the CRT. Certain disadvantages are encountered with a CRT because:

1. The face of the tube is not linear.
2. The phosphor wear and reaction is variable over the face of the CRT.
3. The CRT and associated correction (linearization) circuitry is expensive.

A beam strikes the center of the screen perpendicularly, activating a narrow spot. But at extreme sides, same beam strikes screen at an angle, activating a wider spot. Curvature of screen (not shown) reduces, but does not eliminate this effect.

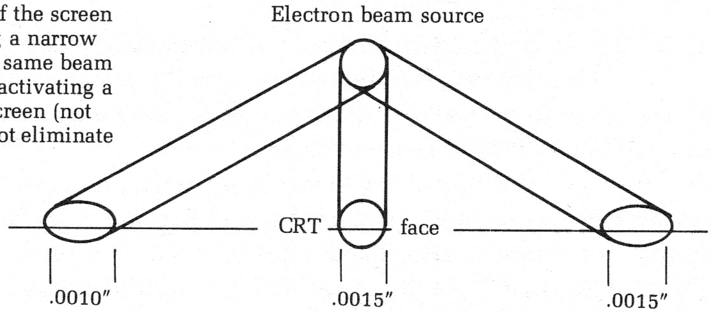


Figure 45. Spot Growth (Exaggerated)

If a spot at the center of the CRT face is 0.001'' it will increase in size as it is moved to the edges as shown in Figure 45. Equally, when the spot is moved up and down from the center point, the same thing will occur. This phenomenon is referred to as spot growth or distortion. In addition to spot growth, focus changes and astigmatism occur when the spot is moved from the center position.

In addition to these imperfections, there are additional difficulties known as pincushion or barrel distortion. These basically involve nonlinearities in movement of the

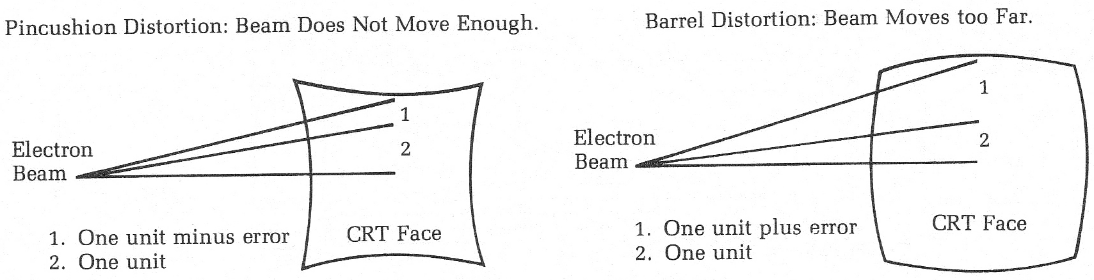


Figure 46. Pincushion and Barrel Distortion

spot. If one unit of deflection (spot moving) energy is used, the spot should move one unit. If two units of deflection energy are used, the spot should move two units. However, it may move less (pincushion) or more (barrel) than it should as shown in Figure 46. It is therefore necessary to introduce correction circuitry to compensate for the spot distortions and to correct movement caused by the nonlinearity* of the CRT. The correction necessarily increases as the spot is moved from the center of the CRT. Because the correction circuitry is expensive, a compromise is reached. That part of the CRT face which requires the minimum correction circuitry while giving the maximum usable area is selected for use, and the far corners of the CRT, where distortion problems are most evident, are ignored. It is also true that the larger the CRT, the greater the usable area and also the higher the unit price.

The phosphor coating on the face of the CRT radiates light when energized by electrons. The phosphor called P11, which is normally used by CRT Phototypesetters, generates a blue light to which photographic emulsions are particularly responsive. The phosphor grain size and distribution determine the evenness of the generated illumination. Phosphoric material ages with time and use. The most used areas will have less response or light output than unused areas. The effective life of a CRT used to be extremely short, less than 500 hours, on a phototypesetter. Now life and performance are much better. Some CRT machines generate characters with horizontal lines and some with vertical lines; all rely on a high speed spot to generate the light. The composite of lines, when completed, forms the character.

The size of the spot determines the resolution on the face of the CRT. It is desirable to have the smallest spot size possible to retain the fidelity of the original character. The advantage of this requirement is offset by the increasing cost incurred as the spot size diminishes and by a reduction in speed because more scan lines are required to cover a given area.

At the CRT center it is difficult to achieve a spot size less than 0.001'', and even more difficult to move (position) and maintain that spot size.

In addition to the selection of spot size is the selection of 'pitch'. The raster pitch is the measurement of the distance from the center of one scan line to the center of the next

---

*Linearity means that one unit of cause (deflection energy) produces one unit of effect (spot movement). Two units of cause produce exactly two units of effect, not two plus or minus an error. It also means that the spot should not grow or change size as it is moved over the face of the CRT.

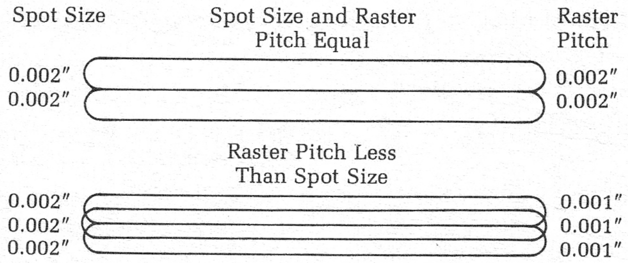

Spot Size
Spot Size and Raster Pitch Equal
Raster Pitch
0.002″
0.002″
0.002″
0.002″
Raster Pitch Less Than Spot Size
0.002″
0.002″
0.002″
0.001″
0.001″
0.001″

Figure 47. Spot Size and Raster Pitch

closest line. Since the spot is circular, it is always overlapped to some degree (as shown in Figure 47.) to prevent density variations or areas being ‘missed’.

The raster pitch is usually less than the spot size. The term scanning, or output resolution must be defined accurately as either the spot size or raster pitch on the CRT face or output material.

The image from the CRT can be enlarged or reduced by the lens system before it exposes the film medium; this will change the effective resolution on the output medium. Resolution is normally expressed as a number of lines per inch and refers to the resolvable (discernible) lines per inch on the output material.

In addition to recording character image on the film output medium, a CRT can be used to scan photographic character masters to produce digital (computer) information which can be used to store the images as shown in Figure 48.

This scanning operation is normally done with special equipment off-line from the typesetter.

The original scanning of the master characters will determine the resolution and type of character image digitised. *(The spot has to be turned on and off to record the outline of the character.)* The spot is not considered off when it immediately encounters the character edge but only when a defined proportion of the scanning spot light is filtered (blocked) out. The image pickup method normally has a threshold based on a percentage of the CRT spot that is transmitted through the master. If 10% of the light output of the spot comes through the master and creates an *on* condition in the *on* output, the threshold is 10%. If it requires 40% of the light output of the spot to produce an *on* condition, the

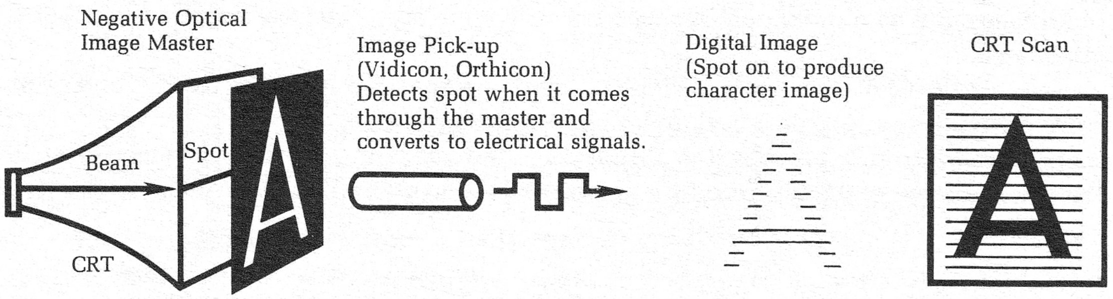
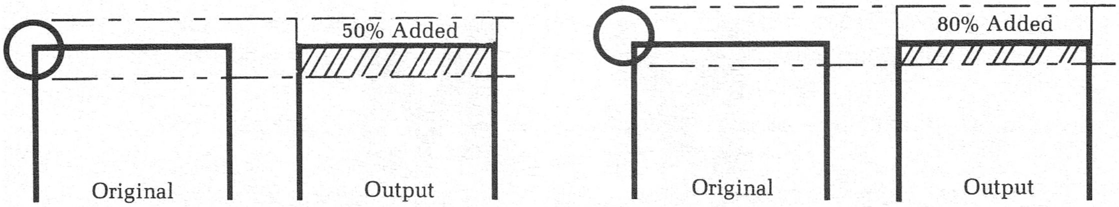

Negative Optical Image Master
Beam
Spot
A
CRT
Image Pick-up (Vidicon, Orthicon) Detects spot when it comes through the master and converts to electrical signals.
Digital Image (Spot on to produce character image)
CRT Scan
A

Figure 48. Scanning of an Optical Master to Produce a Digital Image



Example 1 Example 2

Figure 49. Scan Line Variation

threshold is 40%. In the first example of Figure 49, the threshold has been set at 50%. In the second example the threshold has been set at 20%.

In the example, the threshold choice is clear, a 50% value should be selected. Unfortunately, type design does not consist of uniform width horizontal lines. The problem of selecting the best threshold arises on angled lines and on first change of state when the spot encounters the character. Figure 50, The Staircase Effect, illustrates the problems that arise.

The spot is shown encountering a change of state. Whether or not a *pulse-on* condition is recorded depends on the threshold set. Too low a threshold can generate 'partial' scan lines and can thin the original lines on output. On diagonal lines, improper threshold can highlight the staircase effect shown in Figure 50. With a digital storage system (Digital/Scan), drop out and scanning errors do not present a problem because the character can be viewed and 'cleaned up' prior to use. On Photo/Scan systems, manual correction is not possible and the possibility of spurious scans and imperfections (glitches) occurring always exists. The problem is not so acute on line, screened, and continuous tone artwork but is very critical on typesetting. Figure 51 shows a character which has been scanned and converted to digital form. The character shows typical errors that need correction. It shows a digitised character prior to and after correction.

The number of lines required to reproduce a character in a range of point sizes can either be static or variable. If the same number of lines is used to generate characters in the range 5-10 point, then the spot size must be varied to achieve the different point sizes. This change in spot size results in coarser resolution in the larger sizes and possible variation of density unless the spot light output is increased proportionally to the area covered.

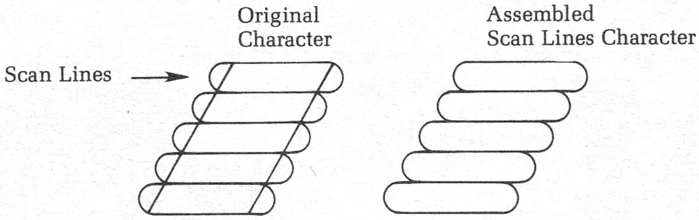


Figure 50. The Staircase Effect

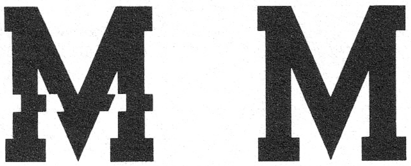


Figure 51. Digitised Character Correction

Normally, Digital/Scan devices have a variable resolution on the output medium so that one master can be used to reproduce several sizes. This saves storage costs.

Similiarly, Photo/Scan devices have a constant resolution on the output medium. Storage consists of one photographic image; the size variations can be made by changing the number of lines to be used when scanning the master character.

Resolution of the output medium is only one way of defining the output and does not automatically indicate the standard or quality which can be reproduced. An output resolution of 600 lines to the inch may be adequate for large point size characters but it is not sufficient for small size characters. As the absolute character size decreases, the ability of each (spot) scan line to impart information decreases. The 72 point character may be clearly defined while the 5 point character may not be. This is because insufficient detail can be conveyed by the limited number of scan lines in the area covered by the character.

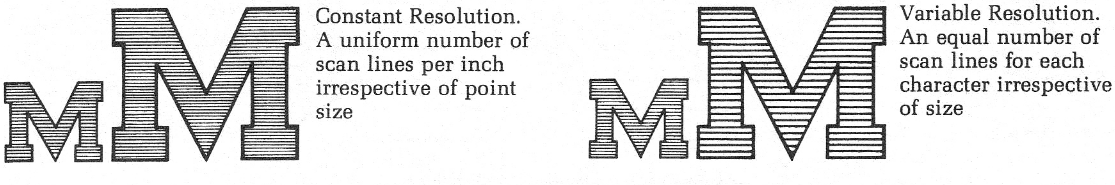
Throughout this chapter the term ‘output medium’ will be used. Currently this refers to photographic film or paper. However, the development pace is so rapid that typesetting techniques ‘record’ information or text directly on what is destined to become the printing surface. For this reason the terms ‘record’ and ‘output medium’ are used in place of ‘expose’ and ‘film.’

B. PHOTO/OPTIC

This category covers the vast range of phototypesetting devices on the market. To be eligible for this category the device must:

1. Store the master character photographically.
2. Generate the character optically for recording on the output medium.

The majority of machines that fit this category store the master character in negative form. This master can be a simple character or a number of characters or typestyles. The unit of storage is variously referred to as a matrix, grid, drum, filmstrip, segment, or other similiar term.



Constant Resolution. A uniform number of scan lines per inch irrespective of point size

Variable Resolution. An equal number of scan lines for each character irrespective of size

Figure 52. Constant and Variable Resolution

In a selection process the required character is selected and illuminated (hence a negative image rather than a positive one). The illuminated image passes into the optical system which:

1. Modifies the original image by magnification or demagnification to obtain the image size required on the output medium.
2. Positions the image, normally only in the horizontal plane, on the output medium.

Vertical displacement is usually achieved by physically moving the output medium with respect to the optical path.

The important point is that the photographic image can be sized (in exact proportions) through the optical system. The number of sizes is limited by the typesetter design. A character at 12 point is an exact proportional enlargement of a character at 6 point. Both characters retain the exact proportional characteristics of the original (master). The limitations imposed by the grain structure of the end product and the effect of optical aberrations generally can be ignored. For practical consideration, the foregoing information is true.

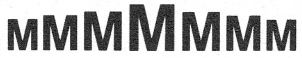


Figure 53. Proportionally Sized Characters

Figure 53 shows exact proportional sizing of characters which have been photoset on a Photo/Optical system. It has been accepted that when a character is enlarged or reduced using a Photo/Optical system it will not show any variation of proportion.

Positioning the image or character in the horizontal and vertical dimension entails considerable use of mechanical systems and inevitably limits the speed of output when measured in terms of modest sized (9 point) characters per hour. The limitation of speed should, however, be recognized as principally a matter of mechanical placement or escapement. Once the placement is achieved, the recording of the character on the output medium can take less than 2 microseconds, regardless of point size or complexity of outline. The act of recording the image is very rapid. The area or block of information which is being processed, once positioned, is the complete character or symbol.

C. PHOTO/SCAN

The machines qualifying for this category:

1. Store master characters photographically.
2. Generate the character by a line or dot generating mechanism for recording on the output medium as shown in Figure 54.

The method of storage is similar to the Photo/Optical machines. Images are usually stored as negative photographic images in units referred to as grids, matrixes, drums, filmstrips, etc.

A selection process presents the required character so that the image can be created and recorded on the output medium.

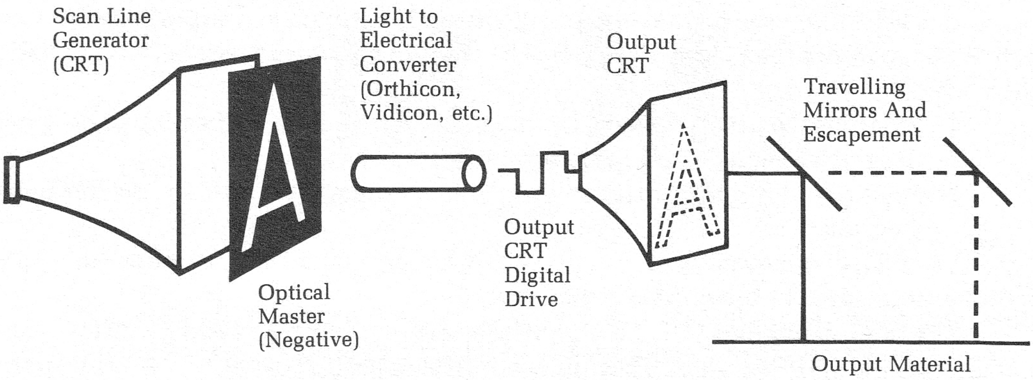


Figure 54. Photo/Scan Typesetter Character Generation System

It is at the output stage that the process varies from a Photo/Optical system. In a Photo/Optical system, once the character or image is selected, it is treated as a 'unit' and passes through the optical system to the output medium. In a Photo/Scan machine, which uses line generation techniques for output, the selected character is divided into segments or 'scan lines'. Translation of the photographic masters into scan lines (output information) is referred to as 'scanning'.

The character is built up on the output medium by a series of closely spaced, varying length lines which together form the character. The output process necessitates that the CRT spot of light be switched on and off in a line in accordance with the characteristics of the image being generated. A normal television set does exactly the same thing except the spot intensity effectively varies to form different shades and hues.

The resulting light image generated by the scan lines is passed through an optical system to the output medium in exactly the same way as on a Photo/Optical system. It is important to note that the character or image is no longer treated as a 'unit' when selected for positioning and recording on the output medium. The character or image now consists of a number of scan lines, each of which has to be generated and then recorded on the output medium. The advantages of this approach are:

1. The electronic horizontal positioning time on a line generator is infinitely faster than mechanically moving an escapement mechanism on a Photo/Optical system.
2. The electrical signal controlling the line generator can be changed or modulated to be longer or shorter. The result is that electronic enlargement or reduction of the character is achieved instantaneously, contrasted with the time taken to mechanically rotate a lens turret for size changes on a Photo/Optical system.
3. In addition to electronic horizontal positioning, vertical positioning can be achieved within certain limits.

The advantage is clear — speed. In practice, these line generation systems are not always phenomenally faster than the Photo/Optical systems. Remember that for one character on a Photo/Optical System the recording time was 2 microseconds for a 72 point character; the setting time including escapement would be 5-10 characters per second. On a line generation machine the output speed for 72 point characters can also be 5-10 characters per second. The reason for this seemingly astronomical drop from hundreds or even thousands of characters per second on text is that the scanning system does not treat each character as a unit. It has to generate a great number of lines to construct a 72 point character. The number of lines to create a 72 point character is far greater than those necessary for a 6 point character. The line generating system can be more accurately thought of as an 'area' device. It will take a given time to generate lines over a large area regardless of whether the area contains one large character or many small characters. Another speed reducing factor is that the character selection method cannot present the character information to the line generating device without appreciable delays. It should also be kept in mind that any device which generates the input or the output signal with a scanning technique does so with discrete lines. (Unlike the photographic process which uses an optical system that translates the entire image to the output medium, the discrete lines are determined by the spot size and scanning pitch.)

D. DIGITAL SCAN

The machines qualifying for this category:

1. Store the master characters digitally.
2. Generate the characters with a line or dot generating mechanism for recording on the output medium.

The characters stored in digital form exist as instructions which, when interpreted by the output device, will generate lines or dots; a multiplicity of which form the desired character. In order to obtain the digital character information, a photographic master is scanned and the scan data is then converted to digital form. This is the reverse process of output. The scanning process divides the character into sections or scan lines, and records the position at which the character begins and ends.

The character now consists of digital information which can be stored in a computer or computer storage medium in the normal computer way. The advantage of storing characters digitally is the speed at which the character can be accessed and rapidly

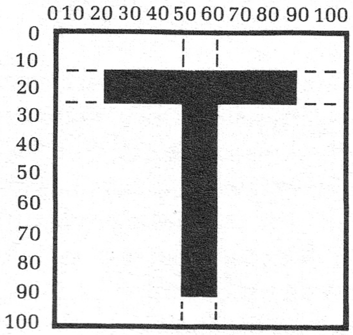


Figure 55. Digitised Character

produced on the output medium through electronic positioning rather than by mechanical movement of optics.

It will be seen that the amount of digital information required to describe a single character is considerable. The amount of digital information is related not only to character size but to character complexity. The more detail that has to be obtained from a character, the more spot switching (on and off) information that has to be stored. As a rule of thumb, for 100 printing characters at 10 point size, approximately 8000 (bit) words of storage are required. As the character size and complexity increase, the required storage size (problem) increases. Only 35 characters at 72 point size can be stored in 8000 (16 bit) words. The precise storage requirement is dependent on typeface, point size, and character design. A sans serif design requires much less storage than a complex script design.

Converting the photographic master characters into digital form is a difficult, expensive, and time-consuming task. Each character, for each font, is drawn oversize on a large (8" × 8" or larger) master. This oversized master is then scanned by a high resolution electronic scanner. The output of the scanner is then processed by computer program and put into digital form (representation). The characters are then output by the typesetter and reviewed for imperfections.

Figure imperfections are corrected by human instructions to complex computer routines which modify the stored digital character representation to produce, on output from the typesetter, the desired character.

The advantage of storing characters digitally is the very rapid rate at which the 'character' can be accessed and produced on the output medium. The positioning process is electronic and therefore very fast. The entire process is a normal internal computer process and the entire process of character generation takes place at computer speeds. The limiting factor is the speed at which the information can be computer translated into output device form. The spot intensity and the speed of line generation determines the overall speed of the typesetter. Extremely fast speeds of up to 600-eight point characters per second have been claimed by manufacturers. The generation of the digital representation of a character is similar to that used for the Photo/Scan method except that is done off-line and imperfections are corrected rather than being reproduced. Once perfect character outlines are stored, they are translated into output scan lines. The scan lines or dots combine on the output medium to form the character.

E. EVALUATION

The evaluation of a typesetting device necessitates a good understanding of how the machine operates. In the final analysis, however, this evaluation is only concerned with whether or not the machine can produce something which can be sold or used profitably.

This notwithstanding, it is necessary to have some formal procedure for evaluating a typesetting device. The work to be set should be classified under one of 11 classifications specified in Chapter 1-F-2. A representative sample of each classification of work should be selected. Because the copy preparation and mark-up is treated as a separate function, these samples can be in 'end product' form; that is, it is not necessary to present original copy and layouts to the typesetter manufacturer. In addition to the type of work, some estimate of the volume of work in each category has to be made. The total volume of work will give an indication of the revenue to be generated; this in turn will enable a maximum investment figure to be estimated. The volume and investment figure equates to a price/performance ratio which the typesetter will have to meet.

Armed with the samples in the different classifications, the prospective buyer should ask each selected manufacturer to set the samples and record the total time taken to set each sample. The returned samples that have an acceptable typographic quality indicate which typesetters are capable of producing the required work. The price/performance ratios and the maximum investment figure will reduce the typesetters to those that should be investigated further.

The evaluation of the end product quality is a subjective decision and can only be decided upon by showing the results to as many knowledgeable people as possible. A consensus should indicate clearly the acceptability or non-acceptability of the quality. One pitfall in an evaluation is to directly ask the question, "What do you think of the quality of this typesetting?" Immediately after this question is posed, the receiver displays his knowledge of typography by finding all kinds of faults with the setting. Indirect, more cautious questions should be used.

In general the quality of the settings is affected by:

1. The original type designs
2. The horizontal and vertical fit
3. Character sharpness
4. Character density
5. The ability of the exposure method to reproduce, as closely as possible, the original design.

F. FUNCTIONAL CHECKS

1. PHOTO/OPTIC TYPESETTERS

The photo mechanical typesetters have a degree of similiarity in that they contain the following similiar elements:

1. Photographic negative storage of characters
2. Light source

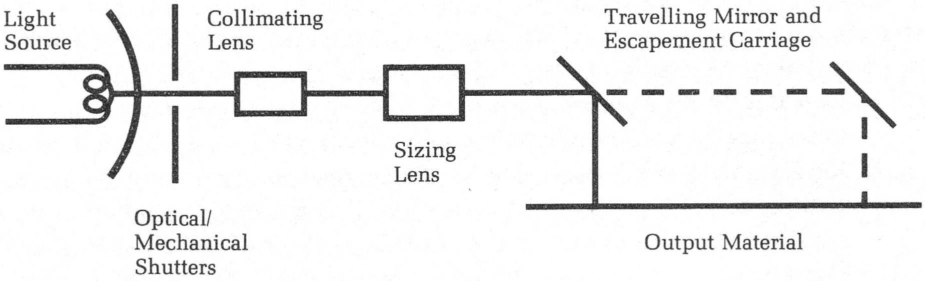

Light Source
Collimating Lens
Travelling Mirror and Escapement Carriage
Sizing Lens
Optical/ Mechanical Shutters
Output Material

Figure 56. Photo/Optic Typesetter Character Generation System

3. Optical alignment to bring several levels to one alignment
4. Optical enlargement and reduction of the character image
5. Optical deflection to the photographic end product
6. Mechanical escapement over a line

Diagrammatically this is shown in figure 56.

In the evaluation of Photo/Optic typesetters, the following should be checked:

1. Life, cost, and replacement time of the flash tube.
2. Tolerance allowed when aligning the flash tube.
3. Control of the light output of the flash tube and the coverage (Does it have a diffuser lens for example?).
4. The size of characters on the photographic master.
5. The time taken to change masters including loading the appropriate character width information.
6. The accuracy of master manufacture and positioning tolerance of characters on the photographic master.
7. Does the optical alignment need readjusting for each change of photographic master?
8. How difficult is it to adjust the alignment? Do film or paper checks have to be run? This can be a time consuming operation.Alternatively, is there a system of alignment which does not require running copy?
9. What tolerance is there on sizing lenses? If two machines are used, both 8 point sizes have to be sufficiently similar to allow copy from the two machines to be intermixed.
10. Are there provisions made to insert density filters or stops to improve density and character sharpness?
11. Can lenses be balanced for density? If so how? What is involved? Who can do it? How long does it take? What is the cost?
12. What tolerances are applied to the escapement mechanism? Does it carry a heavy load? Is adjustment so tight that premature wear occurs on the front end of the escapement mechanism?
13. If the escapement rack is replaced with a mirror, how is the variable optical path length compensated for?
14. How accurate is the magazine system which controls the movement of the photographic material?
15. How good is the focus?

Each machine needs some special checks but the above is a general guide. The following are comments that numerically correspond to the preceding check list.

1. Check with other users. People who have used the machine can give you a more practical calculation than can people who have only talked about it.
2. Run text with the density low and the biggest characters in the horizontal and vertical directions. More often than not, the flash tube is aligned to provide the best light characteristics in the central portions of the most frequently used characters. A large character or a non-centrally positioned symbol, which requires the light from the edges of the flash tube, will show any clipping or

|A|B|C|D|E|F|G|H|I|J|K|L|M

Figure 57. Visual tests for Misaligned Characters

fading of the character image.

3. Run all sizes and typefaces using the largest characters and characters which reach the unusual portions of the exposing window. The resulting test, if underdeveloped, will show more clearly the flash coverage.
4. Does not normally need to be checked.
5. Carry out the operation yourself and check.
6. Check with other users.
7. Check with other users.
8. Check with other users.
9. Run tests and check.
10. Check with other users.
11. Check with other users.
12. To check the tolerance and accuracy of the photographic masters and the escapement mechanism the following tests may help.

    Alternately expose each character on the photographic master between a vertical line or a character which has a vertical line (e.g., I) as shown in Figure 57. Any constant displacement of a character between the vertical line or I character will normally indicate that:

    a. the character is misplaced on the master
    b. the wrong width has been assigned to the character

    To check the accuracy or consistency of the escapement mechanism, expose a number of lines of a vertical line or character which has a vertical stroke. The resulting pattern as shown in Figure 57 will show more clearly any inconsistency in escapement.
13. Expose character which has a vertical line over the maximum line length for a number of lines and check the result achieved through the lines.
14. Set lines of a horizontal rule at a determined leading value over the maximum length of text required several times, and overlay the results.
15. Use a symbol that has an open center (open star).

    With a scan system different problems are encountered:

    1. Improper distortion correction, pincushioning, etc. This can be checked by setting a four-sided figure (diamond) over the maximum line length of the line for a number of lines as shown in Figure 46.
    2. Drop out or skipped scan lines. This can be checked by setting the thinnest vertical and horizontal rules and diagonal symbols.

The resultant set test pieces will determine the acceptable level of the machine's typography.

Obviously each typesetter has its own strengths and weaknesses. The strengths are usually extolled by the manufacturer's sales department; the weaknesses are often elusive. The total functions the typesetter can perform should be contained in a test tape which exercises all the functions and contains as many of the preceding tests as are appropriate. It is important that all the functions and tests are performed utilizing one test tape. The test procedure is designed to assist in evaluating the machine. The decision of acceptance must be based on how the test looks. "If it looks right, it is right regardless of the 'facts'." The tests are only helpful in zeroing in on any problem that may appear in the text.

The following check list is designed to simplify comparisons between typesetters. The list, although very comprehensive, may not cover all the items desired by each firm.

2. FUNCTION CHECK LIST

CHARACTER SET AND POINT SIZES

Description	**Price** **(if applicable)**	**Comments**
Standard Characters in Character Set and Maximum Number		
Optional (No Additional Cost)		
Pi Characters (Additional Cost — from Existing Character Repetoire)		
Pi Characters (from Designs Supplied)		

(1) How are the characters stored: as negative photographic images on a disk, drum, grid, filmstrip, or digitally?
(4) Are pi-mats accessed by the typesetter as normal characters or is there a separate method of accessing and storing pi-mats?
(7) Can pi-mats be manufactured by the end user or must they be purchased from the manufacturer?
(8) What is the range of type sizes (maximum, minimum and total number) available in the machine?

SET UP COMMANDS AND CONTROLS

Lines, sizes and families may also be mixed without interfering with justification or alignment.

Line Length Maximum (Measure)		
Leading Minimum and Maximum Value (Programmed, Standard, End of Line)		
Point Size (Vertical Height)		
Set Width (Horizontal Width)		

Description	**Price** **(if applicable)**	**Comments**
Upper Case and Lower Case		
Addition Lead (One Shot)		
Zero Lead (One Shot)		
Immediate Lead (One Shot)		
Oblique Image		
Embolden Image		
Condense Image		
Lighten Image		
Expand Image		
Maximum Amount of Text that Can Be Set in One Operation (Take Length).		
Mixing Point Sizes within a Line		
Mixing Typefaces within a Line		
Mixing Pi Characters within a Line		
Overset:		
Hanging Punctuation		
Supplementary Line Length (Defined Value)		
Overset Left (Undefined Value)		
Overset Right (Undefined Value)		

TYPES OF LINE

Justified:		
Normal Justified Line Showing End of Line		
Insert:		
Quad Left		
Quad Right		
Quad Center		
Ragged Left		
Ragged Right		
Ragged Center		

Description	**Price** (if applicable)	**Comments**
Quad Middle (Insert Blank)		
Insert Leaders Non-aligned (Em, En, 6 Dot, 3 Dot, Periods, Leader)		
Insert Leaders Aligned (Em, En, 6 Dot, 3 Dot, Periods, Leader)		
Insert Characters Defined X Non-aligned		
Insert Character Defined X Aligned		
Insert Rule		

VERTICAL DISPLACEMENT

Reverse Leading		
Baseline Jump (Deflection from Baseline)		
Superior (High Aligned)		
Inferior (Low Aligned)		
Return to Marked Point in the Text		

SPACE

Automatic Letterspace when Maximum Word Space Equals X		
Manual Letter Spacing		
Automatic Kerning		
Manual Kerning		
Automatic White Space Reduction		
Zero Set		
Figure Space		
Fixed Space		
Relative Space		
Interword Space		
Em, En, Thin, Hair Space		
Set Average Interword Value		
Set Maximum Interword Value		
Set Minimum Interword Value		

Description	**Price** (if applicable)	**Comments**
AREA MAKE-UP		
Define Number of Lines Mark X		
At X Insert Y		
X Not to Be Less than ½ of Line Length		
X Not to Be a Heading or 'n'		
Define Number of Points (Inches, etc.) Mark X		
If X is Less than a Normal Subdivision, Insert Multiples of N at n		
INDENTS		
Indent Left		
Indent Right		
Indent Center		
Multiple Indent		
Hanging Indent		
Indent to Text		
HYPHENATION		
Discretionary Hyphen		
Obligatory Hyphen		
Automatically Generated Hyphen		
Logic Rules Only		
Logic Rules and Exception Dictionary		
Exception Dictionary Only		
Hyphenation Language Change and Reset		
Specify Maximum Interword Space at which Point the Desired Hyphenation Takes Place		
Specify the Number of Letters Preceding and/or Succeeding a Hyphenation Point		
Inhibit Hyphenation		
Maximum Hyphenated Lines in Sequence		
Disable Hyphenation for the Next Word		

Description	Price (if applicable)	Comments
FORMATS		
Create Format		
Store Format		
Use Format		
Change Format		
Chain Formats		
Nest Formats		
SKEW		
Skew Left (QL Down ◥)		
Skew Right (QR Down ◤)		
Skew Centered (QC Down ▼)		
Reverse Skew Left (◢)		
Reverse Skew Right (◣)		
Reverse Skew Center ▲)		
RUNAROUNDS		
Delay Commands		
Delay Execute		
Runaround Left		
Runaround Right		
AUTOMATICALLY GENERATED HEADERS		
Slug Line Film/Paper		
Tag Line Film/Paper		
Output Device		
MULTIJUSTIFICATION		
Set Tabs/M Multijustification 6 Points/Columns		
Set Tabs to Text		
Set Tabs Proportionally		

Description	Price (if applicable)	Comments
Set Text Tabs Stop		
Begin Tab		
End Tab		
Tab Left		
Tab Right		
Tab Center		
Justify Tab		
Insert in Tab		
Tab Around		
Tab Text		
SPEED		
Newspaper Lines Per Minute (Specified by Manufacturer)		
Characters Per Second (Specified by Manufacturer)		
Area Speed (Specified by Manufacturer)		
Speed or Representative Samples of Work to be Produced (Suppled by the Prospect)		
VERTICAL JUSTIFICATION		
Vertical Justification by Points or Specified Unit		
Vertical Justification by Lines		
MISCELLANEOUS TYPOGRAPHY		
Drop Initial		
Raised Initial		
Multi-Flash		
No Flash		
Automatic Ligatures		
Automatic Generation of Fractions (Not in Standard Matrix Generator) form Superiors and Inferiors		

Description	**Price** (if applicable)	**Comments**
Horizontal Rule Generation		
Vertical Rule Generation		
Automatically Cuts Film/Paper on Command		
Automatic Small Capitals by Size Reduction		
Punching of Visual Coding		
Control over End of Take Paper/Film Feed		

DENSITY CONTROL

Automatically Selected form Preset Values by Typestyle		
Automatically Selected form Present Value by Point Size		
Manual Adjustment Specifing Amount and Area of Adjustment		
Film and Paper Setting		

END PRODUCT

Film Type		
Paper Type		
Maximum and Minimum Dimensions Handled		
Material Wastage Fore and Aft		
Time Taken to Change or Reload with New Material of the Same or Different Dimensions		

MAINTENANCE AND TRAINING

Training School Location and Type of Personnel (i.e., Operators, Technicians)		
Nearest Service Department, Number of Trained Staff Relevant to the Equipment in Question		
Service Contract		
Recommended List of Spare Parts		
Recommended List of Test Equipment		

Description	Price (if applicable)	Comments
Recommended List of Auxiliary Equipment		
INPUT		
5-, 6-, 7-, 8-Level Paper Tape (Advanced or Center Hole Sprocket)		
Magnetic Tape (7- or 9-Track ANSI Compatible		
Recording Format for Above		
On-Line Operation (Specifying Master Control Device)		
Floppy Disk		
Recording Format for Above		
Input Justified Zonely or Precisely		
Input Unjustified		
Conversion of Wire Service Tape Line Length		

G. TYPOGRAPHY

The creation of new typeface designs is a never-ending process. It operates under the normal stresses and strains associated with a creative art that has to meet the commercial goals set by the industry. Fashion is the force that has to be acknowledged and accepted as an ever-present motive for change. Typefaces that were orginally designed over 500 years ago are still used extensively throughout the world. They were and are accepted because of their readability, elegance of design, beauty, and distinctiveness. Different designs have emerged throughout the period of printing evolution to meet the different mechanical requirements of new processes. At some point, maybe not clearly determinable, a selection of different designs existed to meet the mechanical demands of every printer, every process, every publisher, and every author. Even though this point has been reached, new typeface designs will continue to be created. As long as man needs to express himself in different ways there will be type designers.

In its general use, the word typography refers to the style, arrangement, or appearance of printed matter. In this new *Guide,* typography is used to refer to all matters associated with the evaluation of quality of the printed characters. The subject is treated under the following headings:

1. The similarity between the original typeface design and the version used for (similarity in reproduction)
2. The typesetting system's ability to resolve the details of the master character (resolution)

3. The character density and consistency (density and consistency)
4. The character fit with respect to vertical and horizontal alignment (vertical and horizontal alignment)

1. SIMILARITY IN REPRODUCTION

The original design for a typeface is usually produced with a particular type of typesetter in mind. Often this is because the manufacturer of a typesetter has commissioned the design, and obviously wants to exploit the acquisition of the new design and also promote sales of his equipment. Eventually this design will become available to other typesetter manufacturers. Even though acquisition may give the right to reproduce a typeface, it is often necessary to modify the design to comply with the physical restraints of the different typesetters. The subtle appearance changes that often occur may be due to one of the following reasons:

1. A different character width system is used.
2. One design is used for all sizes instead of different designs for each size group.
3. Due to a limitation in the system's design, certain combinations of character placement can or cannot be achieved.
4. A different factor of distortion in the system is introduced necessitating a different master character design.

The following comments numerically correspond to the preceding reasons:

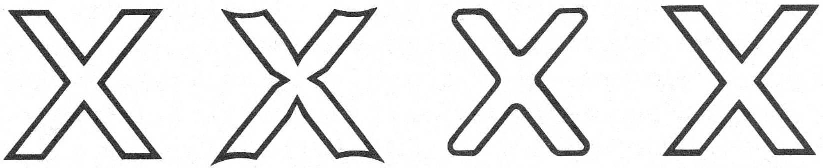
1. If the original design for a typeface was produced for a 36 unit (or half unit) system, many characters could be assigned a 'half unit' value, i.e., 17 units on a 36 unit system is equal to 8½ units on an 18 unit system. If the design is now required to be used on a typesetter using an 18 unit system, then the characters which were originally 8½ units have to be redesigned to fit an 8 or 9 unit value.
2. In some systems, different designs are produced for different point sizes or point size groups. The designs or widths assigned to a character are altered to change the relationship of the space allocated to the character and its image size. This is done to overcome the undesirable visual effect of the space between characters increasing as the point size is increased. In 6 point size the space between two adjacent characters could be 20% of the image area of the character. In 72 point size the same character combination may have a space equivalent to only 10% of the character image size.

Normal
COMMAND
With White Space Reduction
COMMAND

Figure 58. The Effect of White Space Reduction

The visual need for reducing intercharacter spacing as the character size increases is clearly seen in Figure 58.

3. The mechanical or physical restraints imposed by a typesetter design can be many, varied, and subtle. A good example is a character design which was originally produced for a typesetting system that could kern. The character must be redesigned for a non-kerning system.
4. Sometimes the master character is modified (shrunk) to compensate for the distortions of the typesetter when setting large characters. An example is an optical system with a design tolerance that results in large characters being distorted. If the master character is designed to compensate for this, the effect can be reduced or eliminated on the output medium as shown in Figure 59.



Original Character

Reproduction Through a Poor Optical System

Modified Original Character

Reproduction of Modified Character Through a Poor Optical System

Figure 59. Master Character Designs and Their Effect

Taking all of these factors into account shows that because a typeface carries a particular generic name, it is not necessarily identical to the original design or to any other manufacturer's design with the same generic name. That several manufacturers refer to typefaces as Baskerville in no way guarantees that they are identical or even, in some cases, similar. The design of the typeface should always be checked by viewing specimens set on the typesetter under investigation.

In addition to the design differences, the other factor which should be taken into account is point size. It is very rare for two manufacturers to have identical image and body dimensions. The X-height of a given typeface in a given size will not be the same from manufacturer to manufacturer. (See Glossary: Type Nomenclature). On rare occasions, the amount of space allocated to a 24 point character will vary noticeably when measured from baseline

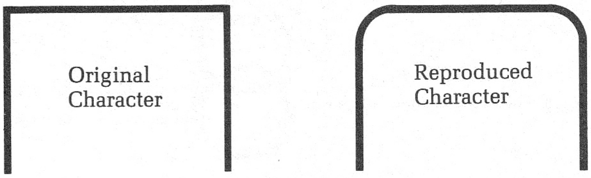


Figure 60. The Result of a Poor Optical System

to baseline.

This combination of point size variations and design variations virtually eliminates the possibility of mixing the output of different manufacturers' typesetters on a line-for-line basis. In blocks, i.e., columns, pages, etc., it becomes even more necessary to make a judgment and establish whether the point size variations are sufficiently different to be noticed unless placed adjacent to one another.

2. RESOLUTION

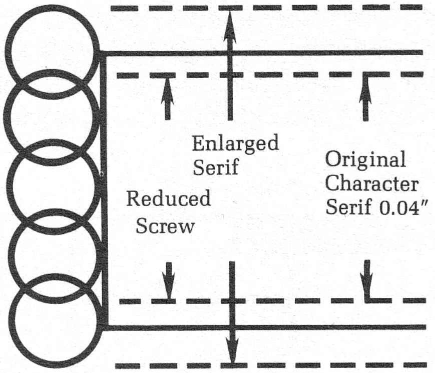
The ability of the typesetting system to resolve the detail of the master character is a function of the system design. In the case of a Photo/Optic system, the resolution of the lenses and mirrors will, to a large extent, determine the quality of image which can be expected on the output material. If the master character has clearly defined corners but, due to lens imperfections, rounding is created, then sharp corners and good images will be unobtainable with that typesetter. This is is shown in Figure 60.

On a Photo/Scan device, the CRT resolution determines the number of output lines generated per inch. If a serif is 0.0045'' and the spot size is 0.001'', then the serif cannot be reproduced exactly as it exists in the original or master character. See Figure 61.

These constraints imposed by the methods of typesetting are important only when their presence can be seen on the output medium with the naked eye.

3. DENSITY AND CONSISTENCY

The control of the density (blackness or opacity) of the character is important because of its effect on subsequent processes in the manufacturing cycle. It is difficult for the human eye to detect and quantify changes in density. It is easier to detect the change with lower densities but the eye is still an imprecise instrument of evaluation. What the eye can detect as only a small change in density, can dramatically affect the subsequent photographic stages.



Depending on when the electron beam first encounters the character image, and the threshold value set to initialize detection, the serif thickness produced by scanning will be 0.004" or 0.0065."

Figure 61. Character Detail Changes Due to Scanning

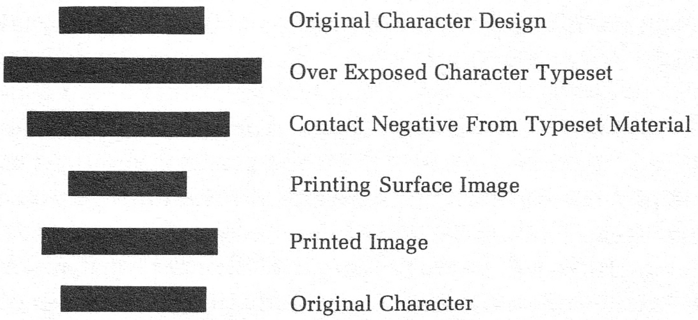

Original Character Design
Over Exposed Character Typeset
Contact Negative From Typeset Material
Printing Surface Image
Printed Image
Original Character

Figure 62. Image Variation Through the Printing Processes

The following is a narrative of the progress of an 'image' through a typical production process. The output from the typesetter is slightly over-exposed which produces a grown image of the characters. In this next process the characters are reduced and the 'growth' due to the typesetter output overexposure is reduced. The resulting negative or positive is placed in contact with the printing surface and exposed (printing down). The image may be slightly reduced in this 'printing down' process. When the printing surface is used and the ink is transferred from the plate to the paper, the ink being absorbed by the paper will spread the ink pigment and the image will grow. The terms 'grow' and 'reduce' mean small changes that occur in each step and are sometimes difficult to detect but the accumulative effect can be considerable as shown in Figure 62.

The sensitivity of the photosensitive material being used must also be considered. If the photographic emulsion has a 'dog leg' curve of response then at some light levels a small change in the light output can dramatically affect the density. If the emulsion response curve is smooth then the same small changes in light output do not create the same dramatic changes in density.

Density control is necessary if the output of several (same make and model number) phototypesetters are to be used together. If the density control is not good, the

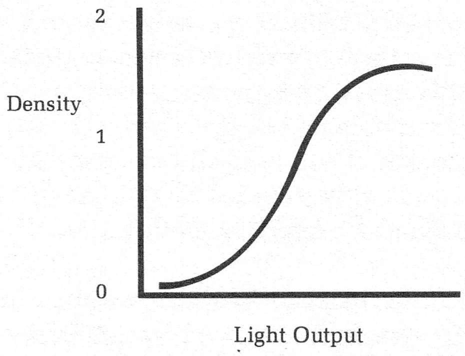


Figure 63. Phototypesetting Paper Emulsion Response Curve

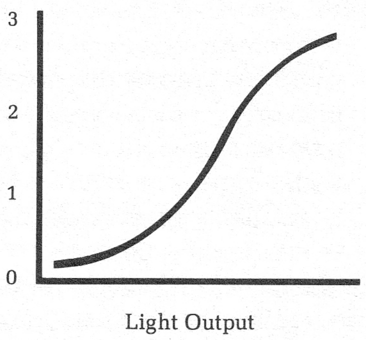


Figure 64. Phototypesetting Film Emulsion Response Curve

difference in weight or thickness of the output characters will be objectionable. Obviously, an underexposed character will appear light and an overexposed character will appear heavy.

Consistency of density from character to character is important, so is consistency of density within a character. With Photo/Optic systems, the light source, the tungsten filament, should produce sufficient illumination to cover the whole character and project it into the optical system. The coverage or illumination of the character should be even over the whole character. However, due to the lamp and filament construction, the characteristic of light sources is that some areas are more brightly illuminated than others. This problem can be overcome by diffuser lenses or by a very bright lamp 'flooding' the character.

If flooding or diffuser methods are carried out successfully, then characters that fill all of the window, the exposure aperture or appear in less frequently used areas of the window will be evenly illuminated. Uneven exposure aperture illumination will result in different densities over the character. Unevenly exposed characters are more susceptible to subsequent over-exposure than properly exposed characters. Underexposed portions of a character can be lost or severely reduced in the subsequent photographic processes.

The aim of density control is to achieve consistency and repeatability within the controls and to produce the desired printed product.

4. VERTICAL AND HORIZONTAL ALIGNMENT

The character's horizontal alignment and fit is affected by:

1. The location of the master characters
2. The associated character width
3. The escapement mechanism
4. The sizing mechanism

Vertical fit can be affected by:

5. The location of the master character
6. The escapement mechanism
7. The sizing mechanism
8. The following magazine or line feed mechanism

The following comments are applicable to the alignment considerations. They are numbered to relate directly to the previously numbered alignment considerations.

1. If the character is displaced consistently to the left or right, the master character could be similarly displaced on the disk, drum, grid, filmstrip, etc. Correction normally requires remanufacture of the matrix.
2. If the wrong width is assigned to a character, it will be positioned consistently with an inappropriate amount of space on either the left or right hand side. Correction can normally be accomplished by operator modification of the relevant width table.
3. Mispositioning of characters at a definite location or place within a line, regardless of the characters involved, often is due to inaccuracies in the escapement mechanism. Either the escapement's counting mechanism has an error and at a particular point the value escaped is incorrect, or a mechanical

malfunction exists which impedes the escapement. Correction can sometimes be accomplished by the manufacturer's service personnel or agent.

4. If the sizing mechanism is incorrectly adjusted, periodic regular changes (errors) in the escapement will be apparent. Correction can usually be made by the manufacturer's service personnel or agent.
5. If the character is displaced consistently in the vertical direction, the master character could be similarly displaced on the disk, drum, grid, filmstrip, etc. Correction normally requires remanufacture of the matrix.
6. If the escapement mechanism is moving or has not come completely to rest before the time character exposure takes place, it could cause vertical displacement. The manufacturer's service personnel may or may not be able to correct this problem.
7. If the sizing mechanism is incorrectly aligned, different size characters may occur on different baselines. This alignment can usually be adjusted properly by the manufacturer's service personnel or agent.
8. If complete lines are displaced, the line feed or leading mechanism is not functioning properly. This can usually be corrected by knowledgeable service personnel. (Please refer to Section E of this Chapter for a detailed listing of problems that can be encountered in typesetters.)

It should always be borne in mind that the final evaluation of typography is by the human eye alone. If the typesetting is pleasing to the trained eye and meets all of the subjective standards set by the purchaser of the typesetting, it is correct. It is only necessary to view text with a magnifying glass when an error has been noted and a more precise evaluation is necessary. Personal whims and fancies should be avoided unless they command an appropriate price tag. The production of high quality, ever-changing typography is an expensive and time-consuming business; much time, effort, expertise, and money have been expended by typesetting manufacturers, printers, and publishers. Very few people have gained from this investment, certainly not the consumer who purchases the printed material. A well produced book is a beautiful thing to behold, but it is unnecessary to exaggerate the standards beyond common sense.

Printing, hence typography, is an art: the art of communicating the most diverse thoughts, wishes, hopes, and desires, as well as recording insignificant to monumental happenings or occurrences. The printed material should communicate in the clearest, most concise manner to everyone who wishes to receive it.

Typography as an art has a distinction over other forms of art in that it should not only please the senses but also inform the mind.

H. SPARES, SERVICE, AND BACKUP

The purpose of this section is to identify and comment on the possible courses of action related to the acquisition and utilization of spares, service, and backup.

The required spares will be subject to several factors:

1. The availability and delivery time of spares from the manufacturers.

2. The degree of anticipated usage of each item, coupled with the the cost and anticipated failure rate.
3. The ability to use the spare part with in-house expertise and equipment.

The following comments are numbered to correspond to these factors above and are given so that an understanding of these factors can be achieved.

1. The first step in determining the spares requirement is to consult the manufacturer and obtain a recommended list. Normally these lists contain consumable items such as lamps, fuses, etc. In addition, a selection of mechanical and electronic components which are calculated to be most useful and which are reasonably low cost, should be compiled in list form. This list should be discussed with as many other users of similar equipment as possible. The discussion should take place not with a manager or an administrator but with the man on the shop floor who knows what spares are used and what most frequently fails. This evaluation should be done with an installation which closely parallels the one under consideration in terms of the equipment type, the ability of in-house staff, type and volume of work, and the associated schedules, etc. Daily newspapers and commercial printers have distinctly different requirements from book publishers. There is little to be gained by a newspaper consulting with a commercial printing installation and vice versa. As a result of this study, a list should be made which should form the basis for spares purchase. Items which should receive particular attention are those that are unique to the particular typesetter in question. The master character images, if they are special because of layout, combination, or design, should be considered carefully when making a spares list. The delivery of any typographic equipment can take a matter of weeks; special requirements may take months (sometimes many months). If only one copy of the master characters or matrix is held in-house and it is fragile, then the response time of the manufacturer supplying such an item is critical. If the delivery time does not seem to meet the schedule requirements of the work being considered then a duplicated copy, or spare master matrix should be purchased. The value of work produced using a set of master characters will far exceed the cost of the duplicate or copy. The unit price may seem high for this spare but the potential loss is far greater.

   The source and object data of complex, expensive, or unique software should be stored in at least two secure locations. The copy used by the production personnel should have a secure fireproof housing, and a duplicate copy should be stored similarly in a different location, preferably in a different building.

2. It may well be that in addition to the manufacturer's list of spare parts, a fairly costly item like a power supply or a tape deck should be kept on hand. If this item is costly but essential to the operation of the equipment, its cost must be weighed against the probable loss of revenue due to machine downtime in the event of failure. Equally, the repair cost of the unit which failed has to be taken into consideration. If the replacement cost is small (a light source, etc.) and the

probability is great that the component will fail, then a spare unit should be purchased. Conversely, if the replacement cost is high and the probability of failure small, then a spare should not be purchased. If the purchase cost of a spare is small and the predicted failure rate is extremely low the spare should perhaps not be purchased.

The temptation to purchase an item just because its price is low should generally be avoided. It would never do for you to find that you have a million-dollar inventory of low priced components.

3. Having ascertained the spare parts requirement, be sure that when you purchase the equipment you have tools adequate to carry out the replacement or repair. Nothing is more frustrating than to find that a machine cannot be repaired because the correct tools are not available, even though the required spare part is on hand. This applies particularly to electronics where a visual inspection usually reveals very little and electronic test equipment is required to locate the faulty condition.

   Also be sure that the inventory of special tools and spares can be utilized by the in-house staff. It is pointless to purchase equipment and parts unless the skilled labor necessary to operate them is available.

1. SERVICE

Service is a difficult thing to evaluate, especially because it changes in a very short time with personnel changes. The following evaluation steps can be taken to be sure that adequate service will be available.

1. Consult the manufacturer to ascertain the services available.
2. Speak to other users of the same equipment in the district or locality to find out what their experiences have been with regard to service.

The service information readily available from the manufacturers usually consists of details relating to the various service contracts available. In addition to this you need to know the names and proficiencies of the service men available to your installation.

Armed with this information, consult with local users to find out their experiences and views. Find out the actual performance and response times of the service people. If this performance is not adequate for your requirements, then additional in-house technical support may be considered.

2. REDUNDANCY OR BACKUP

Redundancy is the continuing ability to operate duplicate equipment on hand. Backup is the ability to produce work by utilizing different equipment or methods. The following examples will illustrate these concepts. If the goal is to travel between points A to B with a car, redundancy would require a second car; backup could be achieved with a motorcycle. In either case, the objective could be met but certain features would be lacking when the backup alternative is used. It would be difficult to transport five people at once and accommodate the luggage on the backup motorcycle. With the redundant car it would be easy. So it is with the production system. A degree of security can be achieved with limited expense, but backup usually restricts certain aspects of the full system. Alternatively, a redundant system can be selected offering complete flexibility at all times. In practice, a combination of the two methods is often used with a typesetter. If a typesetter fails, for whatever reason, it is not possible to limp along. A failure is not an occasion when the machine is out of adjustment and the best results are not being achieved. A failure is when the output from the typesetter is unusable or output cannot be produced. Backup consists of being able to transfer the required input medium, master character set or matrix, appropriate character widths, and software to a similar typesetter, which will accept and operate on the supplied data and components. Whether such a typesetter resides in the locality and could be available at short notice is a matter for investigation. The probability of such availability is usually quite low, in which case redundancy may have to be resorted to and a second typesetter installed.

This redundancy is costly. In order to justify the cost, efforts should be made to increase the work load so that both typesetters will have a cost-justifying work load. When both are heavily used, backup schemes will be sought. Thus, redundancy usually necessitates backup. Always investigate the backup possibilities of the equipment and system before resorting to redundancy.

I. APPLICATION AND COST EFFECTIVENESS

In establishing the cost effectiveness of a typesetter in isolation from the input system, valid comparisons between different typesetters can be made. Having narrowed the field by eliminating the non-contenders, the printer must evaluate the remaining typesetters as part of the total copy preparation system. If two similar typesetters give similar results and cost $20,000 each, but one requires $30,000 worth of input equipment and the other $50,000 worth, all other things being equal, the choice is the first (less expensive) system.

However, in the first place it is necessary to judge the typesetter on its own merits. The principle considerations are:

1. Typographic flexibility: number of typefaces and styles, the character set, Pi-mat ability, point size range, etc.
2. Speed (actual).
3. Typographic quality: range of designs available and standard of reproduction.
4. Price (including necessary options).

J. TYPOGRAPHIC FLEXIBILITY

The cost of typography is high; good utilization is essential. First, the minimum replaceable unit or matrix of storage should be ascertained. Is it a character, type style, or several styles? The preferred minimum replaceable unit is one type style. If the minimum replaceable unit is one type style, when one type style goes out of vogue, it can be dispensed with and replaced with a new style currently in vogue. In this way the masters or matrixes can be 'worked' efficiently. It is expensive to purchase a block (disk or drum) of several type styles just to get one new type face in the block. A prevalent practice in the trade has been to buy a new block (disk or drum) which has a typeface that is on an existing block (disk or drum).

Next it is necessary to determine whether or not different matrixes can be freely interchanged irrespective of character widths. This interchangeability of type styles or small units is essential when different permutations of styles and characters occur with each job. As a matter of economy in minimizing the set up time on the typesetter, the minimum number of matrixes possible should be used consistent with the required typography.

If a large percentage of the work which will be set by the typesetter contains pi-mats unique to a job, or a combination of pi-mats unique to a job, a quick inexpensive method of obtaining or manufacturing the pi characters should be sought. A pi-mat manufacturing system which allows the printer to make pi-mats in-house and mount them on the typesetter is obviously quite useful for printers who require this capability. A reasonable range of pi or special characters supplied by the manufacturer may suffice for some printers. Whatever method for handling pi's is selected, the cost of the special equipment, the effect on the output speed of the typesetter, and the market value of the end product should be carefully calculated.

The method of character sizing should be considered. Is one master design or matrix adequate and able to cover the complete range of sizes the typesetter is capable of, or is more than one master necessary? If more than one master is required, it will increase the cost of the typography but it will also offer the opportunity of selecting modified designs throughout the point size range. This added capability should be evaluated in terms of any improvement in the end product's competitiveness from the standpoint of quality and/or enhanced market value.

Speed is a much easier property to quantify. Most manufacturers quote speed ranges for their devices in characters per second or lines per minute. Each category has to be quantified. With the number of characters per second (cps), one should also consider the point size, line length, and the leading necessary to achieve the stated speed rating. All too often the bland statement of cps is based on conditions optimized to achieve the highest speed rating. When typical work is being set, the cps setting rate is usually significantly reduced. The same considerations apply to the evaluation of speed in lines per minute (lpm). The point size, line length, and leading all significantly affect the (lpm) speed.

In both cases there are certain 'set up' type functions which require a constant excecution time. These must be considered when calculating the effective setting rate. The time taken for the 'set up' function is usually fixed irrespective of whether one or a hundred characters are set. A good example is leading (advance). It does not matter how many characters are contained in a line, the time for linefeed will be constant for a specified amount of advance.

Equally, there are functions which have a variable execution time. Character access time is the time necessary to find the matrix and then locate the character on the matrix. The likelihood of the time taken to access different characters being the same is remote. As a result of all the variables, the best way to evaluate a typesetter's speed is to have samples of the representative categories of work to be produced set on the various typesetters. This true time taken should be equated with the area of text produced. The speed of the typesetter can then be determined in terms of area speed for a given category of work.

K. TYPOGRAPHIC QUALITY

The main consideration for the quality of typography is that the output product be sufficient for the market requirements, but not overspecified. For quality bookwork, the demand for a high standard of typography, both in terms of the original typeface design and the reproduction, is essential. For newspaper production, the standard of typography is not so critical; such factors as speed are far more important. The most important factor is the market acceptability of the product. Samples of the categories of work set on the setting machines should be evaluated by selected end-users, and a consensus view obtained.

The price of typesetters varies considerably from manufacturer to manufacturer. Once it is established which types of machine can be used and what additional items will be required, quotations for the complete package should be obtained from the manufacturers.

When the typesetting machines most suitable for the job are established, the cost of the typesetter is determined, the projected revenue which can be generated can be calculated, and these calculations will allow a rating to be made of the suitability of each typesetter from a fiscal point of view. The overall system (including copy preparation) requirement has then to be taken into consideration before decisions can be reached on the purchase of a typesetter.

CHAPTER SEVEN

REAL TIME SYSTEMS

A. DEFINITION

Real time could perhaps be better called human time since it ideally means that the computer performs its task before the human being notices having to wait. A good real time system can perform tasks for many human beings without making them wait long, thus, giving them the impression that the computer system is working only for them.

A real time computer system is like a steel mill in which the furnace that produces the ingots is working at the same time the rollers are shaping the ingots, thus giving a continuous flow of output product. The older batch process systems were analogous to a steel mill in which only one resource could be working at one time; when the furnace was working, the rollers were shut down or when the rollers were working, the furnace would be shut down.

This real time operation could not be obtained from the older systems which batch processed the composition, so an entirely new system evolution was necessary. The VDT was a major ingredient because it allowed the human to initiate and be in the process cycle by viewing the results on the VDT screen. The real time system makes corrections easily, since problems can be seen on the display screen and corrected through the operation of the VDT keyboard with feedback to the operator. Older systems, involving line numbers and correction tapes, were awkward because the results of the corrective action could only be viewed when the typesetter output the product. Correcting on the VDT screen saves a great deal of film, and cut-and-paste work.

In order for a real time system to be of maximum worth, the VDT operator must be able to instantly see the results of an editing change or composition change. Most systems on the market today have a weakness in that the composition representations on the VDT screen do not impart a good vision to the 'minds eye' as to how the output product will look. Some present systems make no attempt to present composition results on the VDT screen. This is a weakness since errors are more likely to occur in composition than in content. If the composition error is not corrected, the entire take may have to be redone.

The VDT operator needs two types of feedback from the real time program operation: editing/input (contents) and composition. Ideally, these two feedbacks will co-exit and occur without wait as the operator enters raw data or changes to existing data.

B. FILE/DATA BASE SYSTEMS

1. PURPOSE

A file system is a flexible data management facility (sometimes called a data base system) which allows users and programs to access named collections of data, called files. A file may be a take, a page, a chapter, an edition, a book, etc.

Files are the primary means of communication used to implement text flow in an automated text processing system. For example, input text is keyboarded into the system and becomes a file. This file may be edited, hyphenated and justified, proofread, set by a typesetter, copied, and ultimately destroyed by the various operators and programs that interact with the system — all of this without ever being committed to paper except in final typographic form. The file system may also control access to files, denying to certain users or programs the ability to read or write certain files. For example, the sports editor may not be allowed to edit page one stories, etc. These systems provide automatic facilities called queues for dispatching files between the various processing facilities of the system. The data base may automatically keep records concerning files such as the date and time each file was created, who has used the file, and so forth. It may even provide for backup in an automatic way, so that little or no file data is lost in the event of a system malfunction.

2. ACCESS METHODS

There are several ways in which stored data can be accessed in a file system. Two of these ways are important for prepress text processing. The first, sequential access, is used for text and other forms of information which are ordered in a single line and can be retrieved only in that order. Sequential access does not permit reading or writing a piece of information before all of the preceding pieces of information in the file (line) have been accessed. Because it is convenient to do so, text and other kinds of computer programs are stored in sequential access files. Because insertions and deletions are very common occurrences in the text editing process, sequential access files must allow for the addition or removal of data at any point within the file; otherwise, the file would have to be recopied in its entirety every time an insertion or removal was made. (This requirement and its alternative are analogous to the equivalent problem in typesetting, where a hot-metal system has a decided advantage over the phototypesetter which must generally reset the entire take if a line is to be removed or added).

The other common form of access is random access, in which any portion of the file may be read or written, irrespective of its position in the file. This kind of file is especially useful for storing large tables (e.g., hyphenation exception word dictionaries) which are too big to fit in the computer's primary memory but which must be rapidly readable. Most information of this nature is unchanging. Consequently, random access files do not require the ease of modification which sequential access files do.

3. SEQUENTIAL FILE IMPLEMENTATION

To implement sequential access files and still allow insertions and removals within each file, it is necessary that such a file consist of a chain (or list) of records. Each record has a convenient number of characters or words in length and contains three pieces of information:

1. The actual data (e.g., the text)
2. The location of the record which precedes this record in the file (the up link)
3. The location of the record which follows this record in the file (the down link)

Thus, the records are 'chained' together by the up links and down links. To remove or insert a record, it is only necessary to modify the down link of the record above and the up link of the record below, as depicted in figure 65.

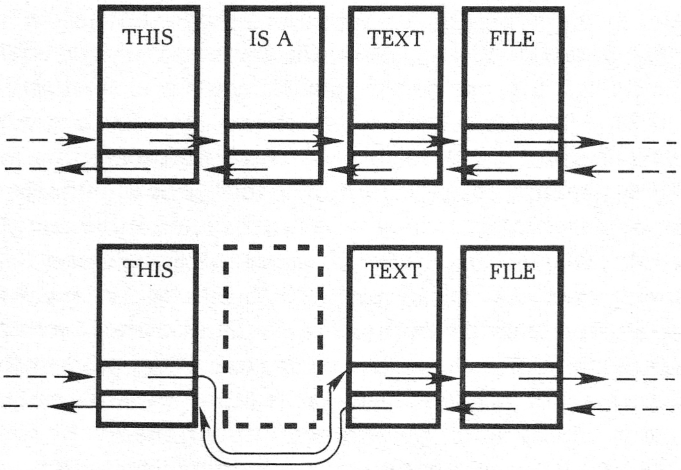


Figure 65. Removal or Insertion of a Record.

If something less than an entire record is to be inserted or removed, the unused portion of the record is filled with a special character or mark reserved for this purpose.

4. RANDOM ACCESS FILE IMPLEMENTATION

Random access files are much easier to implement than sequential files, especially if they do not change in size. It is only necessary to store the records in contiguous locations on the storage device so that, for example, an access to the fifth record of the file is, in actuality, an access to the fifth location beyond the location of the beginning of the file. In this implementation, a need to increase the size of the file may require that the file be moved to another location on the storage device. A large number of increases or decreases in file sizes may result in wasted space on the storage device unless the random access files are recopied into contiguous locations.

5. STORAGE MANAGEMENT

When sequential access files are changed, a different sort of storage space management problem is created. It is not necessary (or even likely) that the records occupy contiguous locations; records removed from such files must be returned to an available space pool so that they may be reused in other files as needed. The pool may be merely a very long sequential file with unrelated content so that removal of a record from a text file is followed by the insertion of that same record in the pool file. Alternatively, a table may be kept which keeps track of all available records on the device. This latter method requires some primary computer storage space in which to keep the table, but results in improved system performance.Space made available because of changes in size of random access files may be used by sequential access files which are insensitive to contiguity of records.

6. BASIC COMMANDS

The basic commands of a file system allow a user or program to read, write, create, and destroy files. To create a file, one merely asks the system to create a file with a certain name and of a certain type (sequential or random). If the file is random access, a maximum size may be allowed. The user is now free to open the file for reading or writing. Opening the file causes the file system to find the beginning of the file on the storage device. If the file is not going to be written, several users may have the file open at the same time. If the file is to be written, no other user may have the file open. (Alternatively, rules which allow simultaneous writing access can be developed. This flexibility is especially useful for queues, which are discussed later in this chapter). Sequential files, once open, may be read or written in an upward or downward direction. It is convenient to allow the sequential file user to have two distinct positions in the file where reading or writing can take place. In this way, the user can conveniently scroll up or down through the file by writing data at one position and then reading it at the other position. Random access files can, of course, be read or written anywhere. Once the user is finished with a file, he closes that file to allow others to access it or he may delete (kill) that file if he desires.

7. DIRECTORIES

To keep track of the locations of files in the system, directories are necessary. A directory is composed of entries, one per file, and each entry contains a minimum of two things: the name of the file and the location of that file on the storage device(s) of the system. Optionally, the directory entry may contain such other information as:

1. The length of the file
2. When the file was created
3. When the file was last used
4. Which user created the file
5. Which users are allowed to read or write the file
6. The contents of the file, e.g., justified text, unjustified text, program, table, etc.
7. The history of the file, i.e., which users or programs have accessed the file, and

in what order
8. Whether a backup copy of the current version of the file exists

The list is potentially endless in that any meaningful attribute of a file could be placed in the directory entry. A useful feature for the user is the ability to edit the directory entries as if they were text; the practicality of this feature is limited by the fact that some of the information should not be written by the user. Another drawback is the fact that directories are used by the system to retrieve locations of files; optimization of the directory structure for this latter task may make the editing of directories by the user a difficult proposition. Still, the user is allowed to access the entries by means of queries to the file system such as 'what is the length of file ABC?' and so forth.

8. DIRECTORY IMPLEMENTATION

There are several efficient ways of implementing directories. Each directory may be organized as a kind of random access file in a special region of the storage device; high speed search hardware can be used to look up vacant entries or file names in this file by reading sequentially. Another method is to hash the directory; this involves somewhat more storage space but offers greater speed. In this scheme, the name of the file is converted into an address on the storage device by means of a hash function which operates in a random but repeatable manner. The resulting address is then used as a starting point in a search for either an available entry (in case the file is being created) or the entry containing the file name (for subsequent accesses). This method is very fast if about three out of every four entries are not in use and if the hash function is carefully designed. The third technique is a tree structured directory in which access to the file is obtained piecemeal by going through several levels of directory. This method is moderately fast and quite flexible.

9. QUEUES

A queue is a file of file names which is used to drive a system process. The process to be controlled by the queue performs its function (e.g., output, justification) on each of the files mentioned in the queue. Conceptually, this process repetitively removes one file name from the top of the queue and processes the file of that name while new file names are being added at the bottom of the queue. Thus, the queue is acting as a buffer between the driven process and other processes which want to make use of it.

Sometimes it is necessary to immediately process a file by a queue-driven process. In such cases, the file name can be placed at the top of the queue so that it will be the next in line to be processed. Alternatively, a process could be driven by several queues: Q_1, Q_2. . . , where Q_1 has highest priority, Q_2 next highest, and so forth. In this scheme, the driven process obtains the next file to be processed from the top of the first nonempty Q_1.

In a text processing system, it is natural to use the doubly linked sequential organization for queues as well as for text files. This scheme has the additional advantage that queues can be handled as text files and may be printed or edited if necessary by the text processing facilities of the system. Of course, a queue cannot be modified by more than one process at a time unless special provision is made in the system to allow this. Even allowing the driven process to remove the top file name while another process is adding a file name to the bottom of the queue, can present difficulties when the queue has only one buffer in it.

10. PROTECTION

It is often important to prevent unauthorized processes to access files. The simplest way to implement protection is to associate a password with each file, and to require that a correct password consist of a combination of one or more of the following:

1. An arbitrary sequence of characters
2. The name (or initials) of the author of the file
3. The name of the process trying to open the file
4. The date or time the file was created

Passwords can be used in conjunction with the other forms of protection discussed below.

A file can be protected from certain kinds of operations. This form of protection is usually implemented by so-called mode or status bits in the directory entry which, if turned on, prevent the file system from performing certain kinds of operations. The most important modes for files are:

1. *Read-only.* The file cannot be written.
2. *Protected.* The file cannot be deleted.
3. *Password.* The file cannot be opened (or its mode changed) without a password.

Of course, a file may have several modes simultaneously.

The third form of protection commonly encountered is called multiple directories. Multiple directories will allow a process to access files in the directory in which it is working; files in other directories are not available to it. The process may or may not be able to change its working directory as desired. In addition, each file may have a directory of processes (access control list) associated with it. These processes are entitled to open the file. The process and the file must refer to each other before the process can open the file.

11. FILE ACCESS COMMANDS

A file access command is a request to the data base within the system to perform some specific task or series of tasks involving file, program, or directory manipulation. Normally these commands are entered on the VDT. The user is identified by appropriate computer action.

Certain file access commands can be accomplished by striking keys reserved for the performance of that function. Other commands must be typed out in symbolic language and interpreted by the central computer. Typing out commands provides an extremely flexible, although time consuming, method for entering commands. For example, if in order to open a file an operator must type the name of the file, type 'open', and strike an execute command key, it is far easier to type the name of file and strike a key labeled 'open'. It is desirable to be able to string or link commands together and strike the execute key once for a series of commands.

The following are essential commands for minimum access operations.

Create File: This command creates a directory entry for a user defined file, queue of files or names. The computer must check to see if a file already exists for that name. If no file exists, the computer establishes a file by appropriate handling of the implemented directory, i.e., random, hash, tree, etc. If a file is a queue, its position in the queue directory area must also be established.

Open: This command allows the user to establish a file with an assigned name within the data base. It is very desirable that files be of any length without practical limitation, otherwise, a multiplicity of files may have to be linked together by the VDT operator commands, rather than being automatically linked by the computer; this can be very cumbersome.

Close (store): This command basically releases a file (the open file) to allow other users (VDTs) to access it. It can also cause an automatic routing to an I/O device, or place the file in a queue.

Rename: This command keeps the file text but changes the file name to the given new name and updates the directory.

Merge: This command combines two files of text together keeping the name and directory entry of only one of the files.

Kill: This command deletes the contents of the directory, returns the storage used by the file to available space, and removes the directory entry.

Compose: This command directs the file to pass through the justification and hyphenation, and typography programs. The file should not be automatically routed to the typesetter.

Typeset: This command directs the file to pass through the justification and hyphenation, and typography programs into the typesetter queue.

Output File to Device X: This command allows a file to be output on device X.

Input File from Device X: This command inputs a file from device X.

In addition to basic services, file systems may provide services to processes in order to make file manipulation more convenient and to provide a single debugged program (which all processes can use) for each of the more common operations. The following commands are desirable but may not exist in a simplistic file system.

Remove Text: This command removes the text of a file but keeps its name and directory entry.

Copy Complete: This command copies the text of a file and updates the directory to indicate a copy exists.

Copy Selective: This command copies selected (usually by VDT cursor) portions of a file and updates the directory to indicate that a portion of the file has been copied (abstracted).

Truncate: This command removes all text beyond a certain point and returns the vacated space to the available space pool. The directory need not be changed, although the statistics on the file should indicate that this has occurred.

Advance Tag: This command tags the file for advance status exempting it from automatic purge.

Sort: Arranges files in a given order such as by alphabet or by size.

Queue Insert or Remove: Inserts or removes named files to queues or from queues.

Load a Program: This command loads a named program into the computer's memory for execution.

Present Format Directories: This command calls a directory of formats to the VDT screen. Formats should be able to be edited in a manner similar to text files. Specifically, the system should allow the following to operate on format files:

1. Create
2. Open
3. Close
4. Rename
5. Merge
6. Kill
7. Truncate
8. Selective Copy
9. Concatenate
10. Check Validity

The check for validity is an operation which looks up all the commands in a file to see if they have been implemented. This check should be implemented in the system.

Search: This command searches all files for occurrences of prescribed text sequences. This command must be implemented carefully since it can place great demands on the system, thus degrading system responsiveness.

12. ERROR MESSAGES

It is important to notify the VDT operator of commands he enters that the computer system cannot understand or execute.

Error messages should be implemented for the following:

Illegal File: This screen return indicates that the file called for has no entry in the directory. Either the file does not exist or the name has been misspelled.

Reserve File: This error message notifies a user (VDT operator) that the requested file is off limits (not accessible for the process).

Device Error: This error message indicates that an improper request has been placed for outputting of the file.

Illegal Sequence: This indicates that an illegal command sequence has been attempted such as Truncate and Copy on the same file at the same time.

Directory Full: This indicates that the available space for directories is full.

Storage Full: This indicates that the available text storage space in the system has been used up.

In typography computations, the most difficult operations are usually those that require the program to make multiple scans or perform a reverse, (looking back) operation on a string of text. A force fit or widow elimination feature, or the implementation of a rule that does not allow more than a certain number of sequentially hyphenated lines are good examples of the necessity of 'looking back'.

If the implemented rule states that more than three hyphenated lines should not occur sequentially, the 'looking back' capability of the programs can be tested in the following manner. Enter two lines with large words that will require hyphens, send these lines through the programs and obtain the two hyphens. Now prepare a third line, send it to be hyphenated, and see how many seconds it takes the programs to complete the process. Doing this test simultaneously on all VDTs will provide a good worst-case-test for the real time typography capabilities of the system. Do not be surprised if the result is not the same with the vendor-claimed typography processing rate of the system (usually given in characters per second).

Next test the I/O devices, such as a printer. Check to see if the code translations are correct. An electronic printer hardly ever has a large enough repertoire of printable signs to allow all required signs to be printed directly. The pi characters almost always have to be translated into code sequence. This requirement can seriously detract from the value of line printer proofs if a great deal of translation is required.

The storage capacity of the system should be tested. Often storage is advertised as the total characters that can be stored. The manufacturer's storage specifications may include program and overhead characters which are not primarily what the user is interested in. The user, in general, is more concerned with the total number of text characters (signs) he can store in the system.

13. SYSTEM BACKUP AND RECOVERY

Inadvertent deletion of files can destroy valuable information unless the information is 'backed up' by file copies. One way to obtain backup is to dump (at periodic intervals) every file in the file system onto a secondary storage device such as a magnetic tape.

This scheme would allow a restoration of the file system to the state it was in at the most recent complete dump, merely by creating the files from the magnetic tape.

A more sophisticated system involves an incremental dump process which runs in parallel with the other processes of the system. The incremental dumper examines a digital bit in the directory entry of each file in the system. If the bit is set *on*, the incremental dumper copies the file onto magnetic tape and clears (turns off) the bit. Whenever the file is written (created) or changed by another process, the bit is turned *on* once again. This indicates to the incremental dumper that another copy must be made.

To restore the system, the incremental dump tape is read in the same order in which it was written and each file is updated through a number of 'generations' from the incremental dump tape until the data is restored. Of course, data modified but not yet copied by the incremental dumper is lost if the system fails.

A still more comprehensive (and costly) scheme for recovery involves maintaining two file systems. This scheme involves duplication of the system hardware and provides a method which makes loss of information very unlikely — all of this at about double the cost of a more rational, conventional system.

14. I/O DEVICE MANAGEMENT

It is important for a system to have smooth and convenient means of performing input and output. Queues (as discussed in the section on file systems) assist in meeting this need; there are other ideas equally important. The 'motherhood principles' of I/O device management are to:

1. Present an interface to the user of the I/O device which is easy to use and is as independent of detailed device characteristics as is practical.

2. Provide as flexible an interface as possible, so that the user can handle data in any format that might be desired.
3. Provide virtual devices for the user so that I/O can be done via file system commands and so that efficient utilization of each I/O device is possible.

These principles are, of course, conflicting and are probably not all simultaneously attainable.

15. WIRE SERVICE INPUT LOADING

On-line wire service input may place a significant load on the processing power of the system. Normally, the users have no control over this form of input, and the input data is broken up into files automatically, providing a virtual device capability (of a kind). Automatic deletion (purging) of files created in this manner is useful because a large volume of material can accumulate in a very few hours or days, clogging the storage system with outdated information. In some situations, automatic deletion based on time-in-system, may be desirable. Deletion can be done whenever the file has been output to a hard-copy device of some kind, or is typeset.

Another important feature of wire service input, is code conversion. This allows data to be automatically converted to the internal code that is employed in the system. Included here is 'stripping', which amounts to deleting certain characters whenever they appear and replacing other characters or sequences of characters with converted equivalents. A complex system may have many kinds of code conversion and stripping going on simultaneously.

16. MAGNETIC TAPE EQUIPMENT

Magnetic tape is important not only as a storage medium but also as a medium of exchange between systems. There are many kinds of equipment on the market, only some of which are compatible with each other. The most common kind of tape transport records nine tracks at 800 (or 1600) bytes per inch; virtually every model of large computer can be equipped with transports of this kind. This particular kind of recording format is an ANSI standard and provides a relatively simple way to transfer large amounts of information from one computer system to another. Of course, the software that reads and writes tapes used for information exchange in this manner must also be compatible.

17. MEMORY AND PROCESSOR MANAGEMENT

The job of an operating system (often called a monitor, an executive, etc.) is to manage computer and system resources. Two resources, namely processors (CPUs) and memories, are interrelated in the way they are managed. A process (task) cannot use a processor unless it has some memory, nor can it use memory very well without a processor (except to do input-output).

In text processing systems, many processes are running simultaneously and using the same system at the same time, so that there is competition for resources by processes.

The operating system must schedule memory and processors among the various processes so that the speed requirements of the system are met.

A system that has 'hard', inviolable time constraints is a real time system. In such systems, certain processes (the ones that are related to the real time constraint) must be guaranteed access to processor and memory within a certain period. Wire service reception is an example of this. If the process that is accepting characters from a wire and storing them on a disk does not get to run, characters will be lost.

Another kind of situation occurs in systems which support interactive access. In these systems there is a 'soft' time constraint; the system must be fast enough to prevent the users from becoming impatient. It has been discovered that a response to a user request in one second or so is adequate performance; at about two seconds delay, the system becomes unpleasant to use.

A. OVERLAYS. The most commonly used memory management technique in text processing is overlaying. The idea is to break the total memory requirement of the system up into pieces called overlays so that only a part of the entire system software is in memory at a time; little-used software then does not occupy space in memory unless it is actually being used. The memory, however, must be big enough to prevent thrashing; this is the constant loading and unloading of overlays with the result that little work gets done.

B. MEMORY MAPPING. Another important memory management technique for text processing is memory mapping. In this scheme, hardware is provided with the processor to perform some kind of address translation on program-generated addresses. In minicomputer systems, this technique is most commonly used to increase the address space size (number of addresses) of the computer. In this way, a minicomputer can address more than 256K locations rather than only 32K or 64K locations.

Another benefit of memory mapping is that it may well allow a kind of 'automatic overlay' capability, usually referred to as virtual memory. In a virtual memory system, a program may be able to address locations which correspond to data not presently in memory. When such an event is detected, the operating system causes the addressed data to be loaded into memory so that the program can use it. Although virtual memory may be more costly in dollars, memory, and time than other techniques, it provides more flexibility than can be obtained with overlays.

18. BACKUP AND RECOVERY WITH EXTERNAL DEVICES

A. VDT BACKUP CONCEPTS. In any large computer system it may be desirable to have the terminals resort to a stand-alone mode to allow the input of copy to continue when the system is down. An intelligent VDT can do this a great deal easier than an unintelligent VDT which depends on logic processes within the main system for its operation.

B. OCR BACKUP. OCR input systems have an inherent backup advantage over

VDT in this area. The inputting on typewriters can proceed without regard to the OCR reader. Both systems are generally alike in that both must be on the air to fully process copy. However, an intelligent terminal should, with emergency programs, be able to punch paper tape that can be read by the typesetter. (Additional backup considerations are given in Maintenance — Chapter 14.)

C. REAL TIME OPERATING SYSTEMS

A modern definition of an operating system would stipulate that an operating system controls the allocation of resources to processes. In detail, this definition means that the access by programs to the facilities of the system — facilities which include processors, memories, input-output devices, and even files containing information — is determined and implemented by the operating system. Conventional operating systems, such as those designed for general-purpose time sharing or batch usage, attempt to maximize the utilization of these resources while maintaining satisfactory response times. In real time operating systems, the task becomes one of guaranteeing systems performance under almost any combination of circumstances. The resource allocation is done to maximize response time rather than resource utilization.

The user's view of an operating system is modified by the programs which interact with that system on his behalf. The only direct view he has is of the file system, which is often available to the user in a form more or less unmodified from the way it appears to programs. Thus, the user can evaluate the file system on the basis of its 'external' appearance. The rest of the operating system must be evaluated indirectly by asking whether it efficiently supports the requests and needs of the programs that use it. It is difficult to distinguish a lack of performance by the operating system from a lack of performance by the programs, but good overall performance implies a good operating system.

D. COMPUTER PROGRAM LANGUAGES

The level of language that the program is written in is an important consideration in real time systems because response is important. There are basically three levels of language. The most difficult is machine language. Writing code in machine language is beyond the ability of most programmers. The next level is assembly level which is basically a shorthand way of expressing machine language. The computer takes the 'shorthand' assembler and converts it into machine language. Most programmers do not have the desire to program in assembly level language and a great number do not have the required ability. The third level of programming is a compiler level such as Fortran. A compiler is more of a shorterhand version than even the assembly level language. Most programmers prefer to program in the compiler level language. The computer basically reduces a compiler to an assembler and then to machine language, wherein the task is performed. The reduction or utilization of the 'shorthand' compiler requires more hardware and takes longer to execute than the assembler. With the cost of programming rising every year and the cost of hardware dropping every year, it would seem logical to prefer that programs be written in a compiler, since the programs would cost less and be readily understood by a broader spectrum of programmers.

In general, there are many business applications programs that could be run on the computer. These applications programs (general ledger, payroll, etc.) are, more often than not, written in a compiler language. Provided the hardware is correct, many of these business programs could be made to run on the electronic edit and composition system, if the composition system software is written in a compiler level language.

It is also important that the language be either a special language developed for typesetting or a standard language understood by a broad spectrum of programmers. The special language may result in more efficient programs, but the disadvantages caused by its special nature should not be overlooked.

E. IMPLEMENTATION CONSIDERATIONS

The implementation of any system, be it large or small, should begin with a system test procedure. Often the printer will feel that it is only necessary for the system to produce some work. This is like buying a car and accepting it because the engine runs — with no regard to heater, turn signals, auto door locks, air conditioning, etc. The vendor may have 'tuned' the system for the specific job you have given him, but what happens when the job changes slightly or you want to add some features? That a car engine runs is no positive insurance that the engine is good — it may use more oil than gas. If you consider all the things that can go wrong on a fully equipped car and multiply them by several hundred, you have some idea of the number of things that can, but usually never do, go wrong with even the simplest system. The first steps in implementation, aside from the site preparation, are the system test requirements, the acceptance test, data conversion, parallel operation, periodic maintenance, and modification procedures.

1. SYSTEM TEST REQUIREMENTS

A good place to begin is to see if the system will properly perform (set) all the typography programs that have been specified for it. The system must also perform the typesetter test routines to test the quality (functioning) of the typesetter. If format and format nesting capabilities exist, a test of some randomly chosen, complex formats should be run. These same general tests should also be run even if the system consists of a stand alone VDT.

The next important step is to test the editing features of the system. An organized list can be derived from Chapter 2 for the appropriate input device. Combine the editing with typesetting and run several tests, particularly to determine if the editing procedures left fractionated typography command codes which the system cannot handle.

Next, if the system is of the real time variety, a check of the real time ability is desirable. A good way to test the real time editing capabilities is to execute a roll up on all VDTs simultaneously and determine how long the wait time is for the last terminal to be serviced (accomplish the roll up). Another good test is to simultaneously insert characters on all VDTs in the first character position of full screen. Next try (on all VDTs simultaneously) a remove of the first character of a full screen. Removes and inserts in the first and last character position of a full VDT memory sometimes produce erroneous results.

2. ACCEPTANCE TEST

Once the system test requirements are determined, the system should be tested against the requirements. A word of caution — in very large systems, since so many things can go on simultaneously, it often takes years to completely debug the system. A general rule of thumb is that for every 8,000 words of code in the operating system, exclusive of applications programs, it might take a year to fully debug the system. Often these bugs do not result in system crashes where everything stops, but in erroneous results on particular operations. Sometimes it is easier to live with these bugs, since only occasionally (under certain dynamic conditions) will errors be produced. A re-run often eliminates the error because the system dynamics have changed when the re-run occurs.

The acceptance test should be run over an extended time and under different system loading conditions.

3. DATA CONVERSION

This is sometimes a costly portion of the effort. For newspapers, these costs may be almost negligible, but for the publisher who prints books where only a small portion of the book changes with every edition, the conversion costs can be considerable. Basically, this process consists of converting the material from whatever form it is in — hot metal, manuscript, etc. — to machine form such as magnetic tape or storage disks. Often it is desirable to perform this work in low level priority (called background) simultaneously with the production work of the day. This is a desirable feature on whatever electronic system one has.

4. PARALLEL OPERATION

This will be required since no system can suddenly appear overnight with all personnel appropriately trained. The old and the new must co-exist for some time until the weaning process is complete. Some firms are unwilling to give up an old procedure because they have used it successfully for a long time. With the electronic system, it may be appropriate to 'stream-line' procedures and eliminate unnecessary steps and hard copies. This may have to be done gradually and in an organized fashion. Some people dream of the day when computers can do the entire job — check content, spelling, grammar, ouput in several languages, etc. — by themselves; these days are a very long way off. The human being will probably be needed forever in a major way in the copy preparation cycle. The electronic system should aid the human being, not replace him. If this is not already apparent, it will become apparent during the parallel operation.

5. PERIODIC MAINTENANCE

The purpose of periodic maintenance is twofold: first, to install program and hardware changes that may be necessary, and secondly, to prevent unnecessary failures.

The date or frequency of periodic maintenance should be established and the necessary action determined. Failure to properly perform periodic maintenance can be costly. Ideally, this maintenance should point out and even prevent failures before they occur.

6. MODIFICATION PROCEDURES

Modifications should be executed in a systematic way with a good deal of forethought and care. Major modifications can affect a great number of aspects, such as operator procedures, system operation, system outputs. Beware that modifications do not consist (in the programming area) of a series of patches. Make certain the program is recompiled after each modification; patches on patches can soon lead to disaster. Make certain that the goals of each modification are clearly understood (a written statement is helpful), that the impact on the system is understood, and the time to execute (leave some safety factor) is known in advance. Determine a schedule and make absolutely certain that the documentation is updated to reflect the modification.

F. FORMAT HANDLING

1. DEFINITION

Formats, in a general sense, are combinations of files that have one common directory entry. In practice they are collections of typography commands and texts that are used repeatedly.

2. PURPOSE

The purpose of establishing typography formats is to eliminate the need for lengthy keying in all of the command codes for certain typographical configurations that are used repeatedly. The text and the typographical format codes are interleaved together. A break code is used to tell the computer to go fetch the next group of typographical command codes and put it into the text at the break code positon. Text entry is accomplished until a need for typographical command codes arises, then a break code is entered rather than the individual typographic command codes. The computer fetches the command codes and inserts them into the text. Text entry is then continued until the need for additional command codes arises, at which point a break code is entered. This method is repeated as often as required to complete the job.

Without Format	**With Format**	**Codes in Format**
TEXT+QL+IR	F1TEXT	F1=QL+IR+AL▲
+AL+Text	▲Text▲text	QC+AL▲
+QC+AL+text		

▲ = Break Code
QL = Quad Left
IR = Indent Right
AL = Add Lead
(fixed increment)
QC = Quad Center

Thus, it can be seen that the use of formats can considerably reduce the entering (typing) of command codes. One of the problems in the use of formats is the requirement that the typist must remember the formats, otherwise the copy must be marked up appropriately by a mark-up person who must remember the formats.

If a directory of formats can be called on the VDT screen, it could assist in remembering and consequently increase the utilization of formats.

3. FEATURES

It is highly desirable that formats be put into the system in an easy manner. Ideally, they should be put into the system as normal text with a file name indicating that the file is a format. In a stand-alone VDT, formats could be stored as small paper tapes which were entered prior to the work (job). Some systems require a computer operator to toggle the formats into the system by manipulations of the switches on the computer front panel.

A. *Length:* A highly desirable property is one that allows the formats to be of any length yet not waste computer storage if the format is short. A fixed limit on the number of formats that the system can have is not desirable. Any number, any length (within the limits of the storage) is the most desirable situation.

B. *Stringing:* This is the ability to call one format after another without limit, i.e., F_1+TEXT+F_2+TEXT+F_3+TEXT+F_4+TEXT+Fn. Repeated calls of the same format should also be allowed.

C. *Nesting:* This is the ability to start with one (original) format (F_1) and, before it is completed, go to another format (F_2); complete F_2; then return to the original format. This is sometimes complicated to use but if the formats can be remembered by the operator or mark-up person, this can be a highly desirable feature.

Note: if the break code (break to format) is not inserted into the text at the appropriate location an erronous result will usually occur. In newspaper production, formats can be extremely valuable since they can save a great deal of time. Another desirable feature is one that allows formats to have pre-defined text within them. If a format is called that is empty or non-existent, some type of format call error should be indicated to eliminate the possibility of finding out afterwards that the typesetter has output a worthless product.

CHAPTER EIGHT

APPLICATIONS OF REAL TIME SYSTEMS

A. CLASSIFIED AD SYSTEM REQUIREMENTS

This section describes the system requirements for the classified ad taking process. Although specific details will vary from one newspaper to another, the basic system requirements are invariant.

1. GENERAL REQUIREMENTS

A. FORMS. The ad taking form must be user defined. It contains the business data required from each ad as well as the ad text. OCR systems generally use preprinted forms; VDT systems use a form called to the screen by a single keystroke. The form will contain two types of information: the text, and data relating to the attributes of the account, i.e., date of insertion, cost rate, etc. Provisions must exist for entry of multiple ads with one form.

B. FILLING OUT FORMS. This basically consists of filling in the data required on the form, and is usually done by a typist. The validity of the filled out form should be checked by either visual or computer methods. The validity of the telephone number and the account number are two form entries that should always be checked. The account numbers generally fall into four categories:

1. Transients
2. Ledger
3. Existing account numbers
4. New account numbers

C. CREDIT CHECKING. If credit checking is to be done, it should be done for the following:

1. Telephone Booths

2. Ledger account
3. Transients
4. Outstanding balance reports
5. Hourly poor-credit reports

D. ENTERING THE AD TEXT. When the ad is entered, the following are the major steps:

1. Determine layout/style
2. Compose ad or take ad
3. Estimate or calculate ad fit
4. Estimate or calculate depth and/or cost

E. MODIFICATION REQUIREMENTS. Provisions must be made to allow the following modifications on a previously entered ad.

1. Change text or classification
2. Change insertion dates
3. Lengthen or shorten expiration date
4. Recompute cost
5. Correct cost error

F. STATISTICAL REPORTS. There are basically two types of reports that are required from any electronic system when taking ads: daily statistical reports and general accounting reports. The daily statistical reports consist of the following:

1. By classification:
    a. Total column inches and linage (perhaps needed sooner than daily reports, ideally upon request)
    b. Total column inches by classification
    c. Ads with box numbers
    d. Out-of-town ads
2. By ad-taker:
    a. White space, black space and total column inches
    b. Expiring ads
    c. Ads killed
3. For Accounting:
    a. List of new accounts
        1. Account numbers (must be distinctive from other numbers within the system)
        2. New lists should be made every day

G. GENERAL ACCOUNTING REPORTS. Consist of at least the following items:

1. Expired Ads
    a. Attribute files for expired ads
    b. If more than one edition — ads for morning only, evening only, or

    morning and evening
2. TF ads (till further notice ads)
    a. TF ads should be included with expired ads at month end
3. Killed Ads
    a. Ads that have been killed should be included with expired ads
    b. When an ad is killed its cost will be recalculated
4. Other accounting reports that can be programmed into the system without seriously degrading the system's ability to take ads

2. QUICK PROFITS — A CASE STUDY

The adoption of automatic systems for the production of classified advertisements has long been heralded as a worthwhile and significant achievement. The advantages accruing through such systems include:

1. Reduced cost
2. Simplification of ad-taking
3. Elimination of multiple keying of text
4. Use of formatting procedures
5. Improved schedule and deadline times

There are several methods and systems available for the collection, billing, administration, and production of classified advertisements or portions of this task. Each may use different permutations of the hardware currently available and most have special software.

It is not possible to be specific in relating the effectiveness of each available electronic system package without first knowing in detail the requirements of the specific newspaper or newspapers. Items of critical importance include:

1. Method of classification
2. Volume of ads repeated
3. Volume of new ads
4. Schedule requirements
5. Accounting data required
6. Production data required
7. Administrative data required
8. Method of ad taking
9. Method of production
10. Artifical political restrictions on labor or work movement

It is, however, possible to draw one or two conclusions from the experience gained by numerous users of a real time VDT computer and storage type of system. One particularly well-documented system involved a capital expenditure of $250,000; increased material and running costs amounted to $100,000, but the labor costs savings were over $254,000 annually. This generated a gross savings of $154,000 per annum, allowing capital recovery in the space of less than two years. The system was installed in 1973 and the relevant data prices, wages, etc., refer to that year. Significantly, the labor cost savings were distributed as follows:

Table Eight. Cost Savings in Classified Ads.

	Cost Savings	% of Total
Paper checking, checking errors, ad takers, etc.	$83,890	33%
Accounting, credit writing, keypunching, etc.	$55,733	22%
Composing operators, proof reading, etc.	$144,768	45%

Note that over 50% of the labor cost savings were achieved outside of the production area where the system was primarily designed to function.

3. A CLASSIFIED ADVERTISEMENT SYSTEM FEATURES CHECK LIST

- Classification by: date of insertion
  - size
  - alphabetic sequence (number of letters)
  - alphabetic sequence by group
- Billing information by: ad
  - customer
  - issue
  - group or classification
- Volume by: inches
  - linage
  - picas and points
- Entry contains: block sequence
  - identification insertion by publication
  - start data
  - bill date
  - skip date
  - scatter data
  - identity of classification(s)
  - operator identity and data
  - billing data
- Statistics by line count for: customer
  - classification
  - section
  - total
- Advertisement count by: customer
  - classification
  - section
  - total
- Operator statistics: original keystrokes
  - original linage
  - correction keystrokes
  - correction linage
- File: opening time
  - closing time
- File use historical status by: device
  - operator
  - operation
  - idle device
  - busy device
- Circulation data by: carrier
  - route
  - subscriber
  - draw changes
  - route changes
  - route lists
  - draw lists
- Accounts receivable: credits and debits by draw list
  - carrier billing
  - district audit
  - total audit
- Subscriber: renewal notice
  - revise notice
- ABC audit by: route

  - district
  - press run
  - spoilage
  - free copies
- Advertising record by: publication
  - date
  - day
- Advertising revenue by: publication
  - day
  - classification
- Sales performance summary by: salesman
  - office
  - district
- Accounts payable by list
- Payment generation
- Payroll: master file modification
  - security
  - payment generation verification
  - payment reconcilation

B. NEWS HANDLING

1. GENERAL REQUIREMENTS

The following are some of the primary considerations (apart from editing and real time response) in the news handling portion of the system.

Conversion of input form into desired form often means stripping out the wire service justification and restoring the copy to 'idiot' unjustified form. The aspects of this are given in the section entitled 'Wire Stripping/Receiving'.

The following are requirements for news handling.

1. Establishing a means of abstracting the wire articles and establishing a directory scheme with the system.
2. Establishing automatic queuing procedures to route the wire articles to appropriate departments within the newspaper. Establishment of hierarchical access schemes are required.
3. Automatically clearing the memory of articles not tagged 'advance copy' or designated as 'save.'
4. Establishing an audit trail for legal or other reasons.

2. DIRECTORY METHODS

A desired way to establish directories for the system would be to base the directories on content. Ideally, the wire service should establish abstracts which could be used as directory entries. This is a difficult task since stories are usually never written with only one item of interest. A great deal of effort has gone into this subject without yet producing simple-to-implement results. More commonly, the directories are based on the wire over which the story was received. Stories are dated and numbered for each wire. These dated numbers form the basis for most present directory approaches. The ability of the system to selectively sort (search under mask) from the story numbers is very meaningful if the number represents categories of content rather than serial numbers given to stories as they are sent over the newswire lines. The serialization could be based on the time the story was transmitted rather than by assigning numbers to a story. The story numbers, like a simplistic Dewey Decimal System, would denote the subject contents of the story.

However the directories are established, it is necessary to be able to combine selective parts of different wire stories and merge them with locally generated copy. Obviously, unlimited editing, deleting, changing, and adding are absolutely necessary; the ease with which these can be done depends upon the editing power of the system and the method in which the directories are established.

Ideally, the directories should have no practical limitations on the number of entries or upon the length of each directory entry. To allow editing of the directories is, on the face of it, a nice feature. However, it requires some serious consideration unless the edited directory is only temporary or only for a given user.

A. AUTOMATIC QUEUING PROCEDURES. These are procedures within the system to automatically route copy flow. Unless the electronic system has been designed correctly, the queue manager within the system will interfere with the data manager and reduce system efficiency. Although automatic queuing procedures are nice to have, their impact on system performance should be considered. With queuing, certain jobs can be restricted to certain editing or copy processing stations. The operator, to obtain the next job, merely makes a 'next' request rather than searching through a directory. For small newspapers, the queuing procedures can be kept simple since few persons normally handle one story article before it is either printed in the paper or discarded.

Hierarchical access methods can sometimes replace the queuing requirement, but normally, they will complement the queuing procedures. By hierarchical access, we mean a limiting of the access to certain positions or individuals as the copy progresses — thus, copy originated by a person may not be available to that person after it is edited on a certain level. The queuing procedures must be well thought out. If the system performance is degraded by too much queue programming, the queuing may be traded for some operator routing of copy to achieve appropriate balance.

B. AUTOMATIC CLEARING/PURGING. This is a necessary process to keep the system's memory from filling up with the never-ending flow of news copy generated by the wire services. This clearing is normally done by a real time clock (hopefully a hardware type) within the system which could inaugurate clearing on the following basis:

1. X* minutes after a story has been typeset.
2. At press time.
3. After a story is X hours old.
4. After advance copy is X days past.
5. On a priority schedule when memory is X % full.
6. Other unique user requirements.

* X is a user-defined number.

C. LIBRARY/AUDIT TRAIL. At the present time an audit trail is difficult to achieve with electronic systems since two copies of an article cannot generally exist side by side on the VDT at the same time. The audit trail requirement must be considered very carefully since an improper imposition of 'nice to have but not essential requirements' can unduly complicate the system. Since the output product is retained in the newspaper library and the newswire input can be reestablished, it may not make a great deal of sense to pin down too many in-between steps. The establishment of common newswire directories, in a form similar to the Dewey Decimal System or a derivative thereof, could form the rational basis upon which audit trail could be constructed. Electronic systems can generate other forms of output in addition to the typeset newspaper. These other outputs (line printers, etc.) could be entered in the library files along with the information that is presently filed. If the directories were established properly, the outputs could include a filing label and several cross index labels as well.

3. WIRE STRIPPING FOR 6-LEVEL TTS — A.P. NEWSWIRE

Many newswire services provide their subscribers with news in a fully justified and hyphenated format. This allows those subscribers to take their perforated paper tape from the wire service and feed it directly to a typesetter. Two type sizes are usually provided: one for financial, stock market information, and sports; and one for normal news text.

Many newspapers find that they prefer to do some editing before publishing the text they receive from the wire service. Any changes to the justified text make it necessary for the item to be unjustified and rejustified. Most large newspapers have some facility for performing their own hyphenation and justification, so they do not need to maintain copy in a justified form.

Newspapers with electronic newsroom facilities, VDT displays, etc., find that it is inconvenient to view justified text. It also becomes necessary to remove fixed or hard spacing before sending the text to their typesetter.

For all these reasons, a process to 'un-do' the hyphenation and justification becomes desirable. The wire stripper is such a process. It takes justified text and converts it back into unjustified text with no fixed spacing (except possibly an em space at the beginning of each paragraph).

Before the 'un-do' process can take place, there are a few preliminary things which must be done to the TTS information that comes off the wire. The shifts or unshifts are usually taken care of at a very low level — usually in the routine which 'gets' the next character. Since an unshift code precedes a discretionary hyphen, the condition could be checked for by setting a flag every time an unshift was received. Each time a hyphen was received the 'unshift received last' flag would be checked. If the flag was set, the hyphen would be stripped. The 'unshift received last' flag would be cleared for all characters other than unshift.

Another technique would be to check the penultimate character received each time a new character was read. Then when a hyphen was detected, the penultimate character would be checked to see if it had been an unshift. If so, the hyphen would be

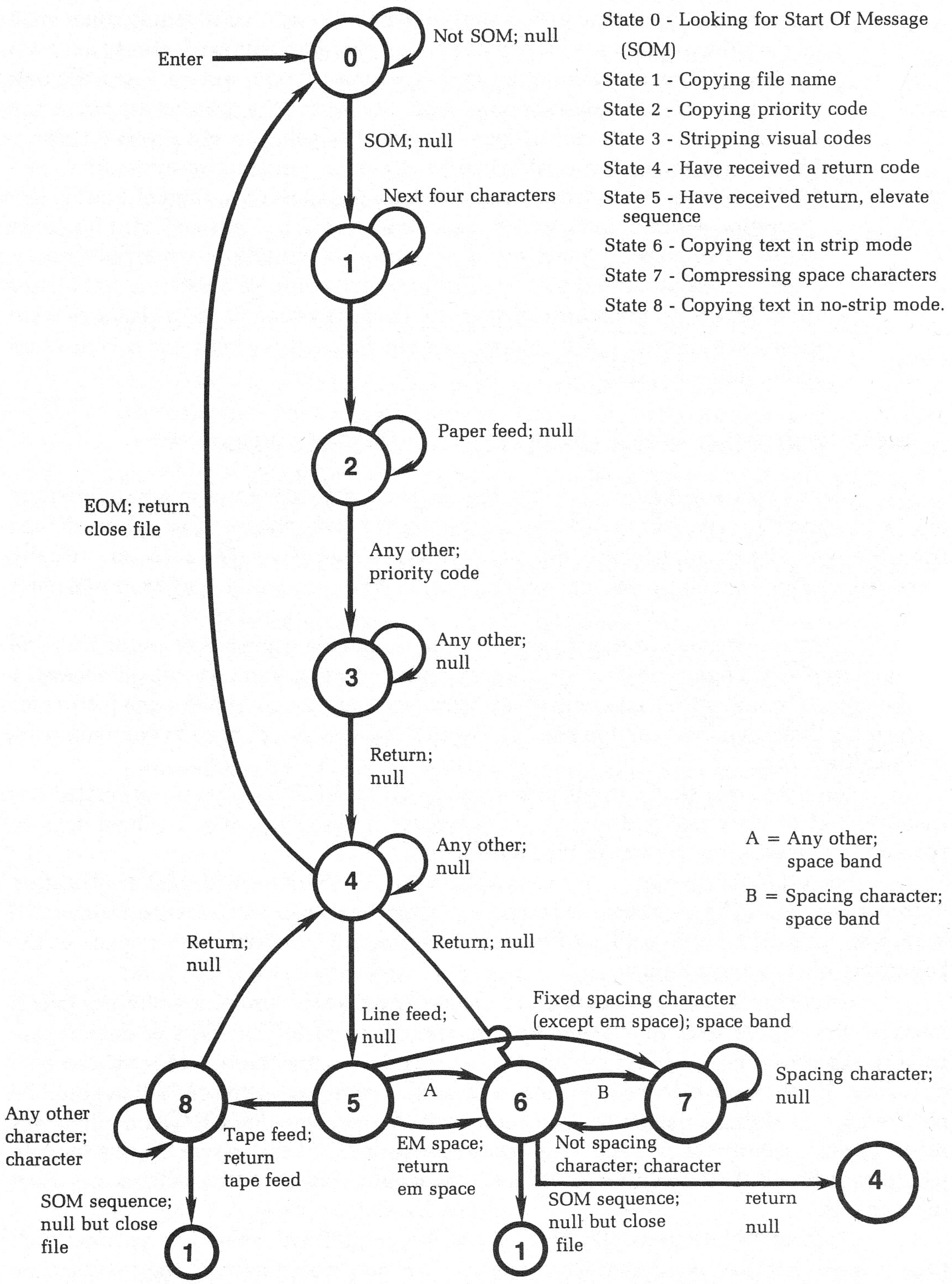

State 0 - Looking for Start Of Message (SOM)
State 1 - Copying file name
State 2 - Copying priority code
State 3 - Stripping visual codes
State 4 - Have received a return code
State 5 - Have received return, elevate sequence
State 6 - Copying text in strip mode
State 7 - Compressing space characters
State 8 - Copying text in no-strip mode.
Enter
0
Not SOM; null
SOM; null
1
Next four characters
2
Paper feed; null
Any other; priority code
3
Any other; null
EOM; return close file
Return; null
4
Any other; null
A = Any other; space band
B = Spacing character; space band
Return; null
Line feed; null
Return; null
Fixed spacing character (except em space); space band
8
5
A
6
B
7
Spacing character; null
Any other character; character
Tape feed; return tape feed
EM space; return em space
Not spacing character; character
SOM sequence; null but close file
1
SOM sequence; null but close file
1
return
null
4

Figure 66. Wire Stripping Algorithm (6-Level)

current state	input	output	next state	comments
0	SOM code	null	1	
0	any other	null	0	
1	any 4 characters	null	2	open a file with 4 character name as received from the wire.
2	paper feed	null	2	
2	any other	character	3	put priority code into file
3	return	null	4	
3	any other	null	3	
4	elevate	null	5	
4	EOM sequence	return, em sp.	1	close current file
4	any other	null	4	
5	tape feed	return, tape feed	8	this switches to no-strip mode
5	em space	return em space	6	this is paragraph end & switches to strip mode
5	any other fixed space	spaceband	7	strip mode, compressing spaces
5	(any other)	spaceband, character	6	
6	return	null	4	
6	fixed spacing character	spaceband	7	
6	SOM sequence	null	1	close current file
7	fixed spacing character	null	7	
7	return	null	4	
7	any other	character	6	
8	return	null	4	
8	SOM Sequence	null	1	close current file
8	any other	character	8	

Table Nine. 6-Level Wire Stripping State Table

stripped, otherwise it would be treated as an obligatory hyphen and would be retained.

A wire service input package for an electronic newsroom editing system should have the following capabilities:

1. Recognize the start of story code sequence.
2. Recognize the name assigned by the wire service and maintain this name.
3. Recognize and record the priority assigned to the story, possibly flagging high priority files in some manner.
4. Recognize tabular text and not strip it.
5. Recognize non-tabular text so as to be able to strip unwanted spacing, hyphens, and line end codes.
6. Recognize end of story code sequence and close the file at that time.

7. Disregard anything occurring after an end of text until the start of the next item.

A wire stripper algorithm based on assumptions that follow is given Figure 66.

1. The wire is an Associated Press 6-level format (TTS code).
2. The start of message (SOM) is 3 lower rails or 3 quad rights.
3. The file name is an alpha character and 3 numerics.
4. The file name is followed by a paperfeed.
5. The paperfeed is followed by an alpha character which indicates priority.
6. If visuals are sent, they will be terminated by first return code.
7. If no visuals are sent, the priority will be followed by a return.
8. Every line of tabular material will begin with a tape feed code.
9. The end of text code sequence will be shift, return, unshift.
10. The paragraph end code sequence is return, elevate, em space.

The use of 6-level newswire transmission, while still available, is being supplanted by 8-level USASCII transmission adhering to the ANPA/RI standard which was originally published late in 1974. More and more newsrooms are converting their operations from punched paper tape to electronic equipment which captures data directly from the wire service data drop and stores it in the newspaper's data base. In such a form it is ready for instant retrieval onto VDTs for review, rewrite, or typesetting.

4. ALGORITHM FOR RECEIVING 8-LEVEL NEWSWIRE.

Inputting 8-level newswire into an electronic composition system requires a detailed understanding of the characteristics of the wire transmission. An algorithm is given which imparts that understanding on a computer programming level.

The coding used in the transmission is 8-level USASCII with special meanings given to a few of the normal control codes. This algorithm is based on the assumption that an AP/UPI/ANPA standard message format consists of:

1. Two synchronizing characters followed by a start of header (SOH) character
2. An alphabetic character (which denotes category if AP) and four numbers for the file name
3. A variable length block terminated by a
4. line feed followed by the
5. priority code followed by a
6. space.
7. An alphabetic character for the category
8. Body/agate indicator
9. Text/tabular switch
10. Space
11. Keyword (maximum of 8 characters) followed by a
12. space followed by
13. date then
14. word count then
15. return, line feed, start of text (STX) then
16. variable length block of text in which paragraphs are delimited by an HT code

In state 1 or 2, an ETX will force system to state zero.
In states 3, 4, 5, or 6, an ETX will force the current file to close and return to state zero.
In states 1 or 2, an SOH will force system to state 1.
In states 3, 4, 5, 6, 7, or 8, an SOH will force the current file to close and go to state 1.

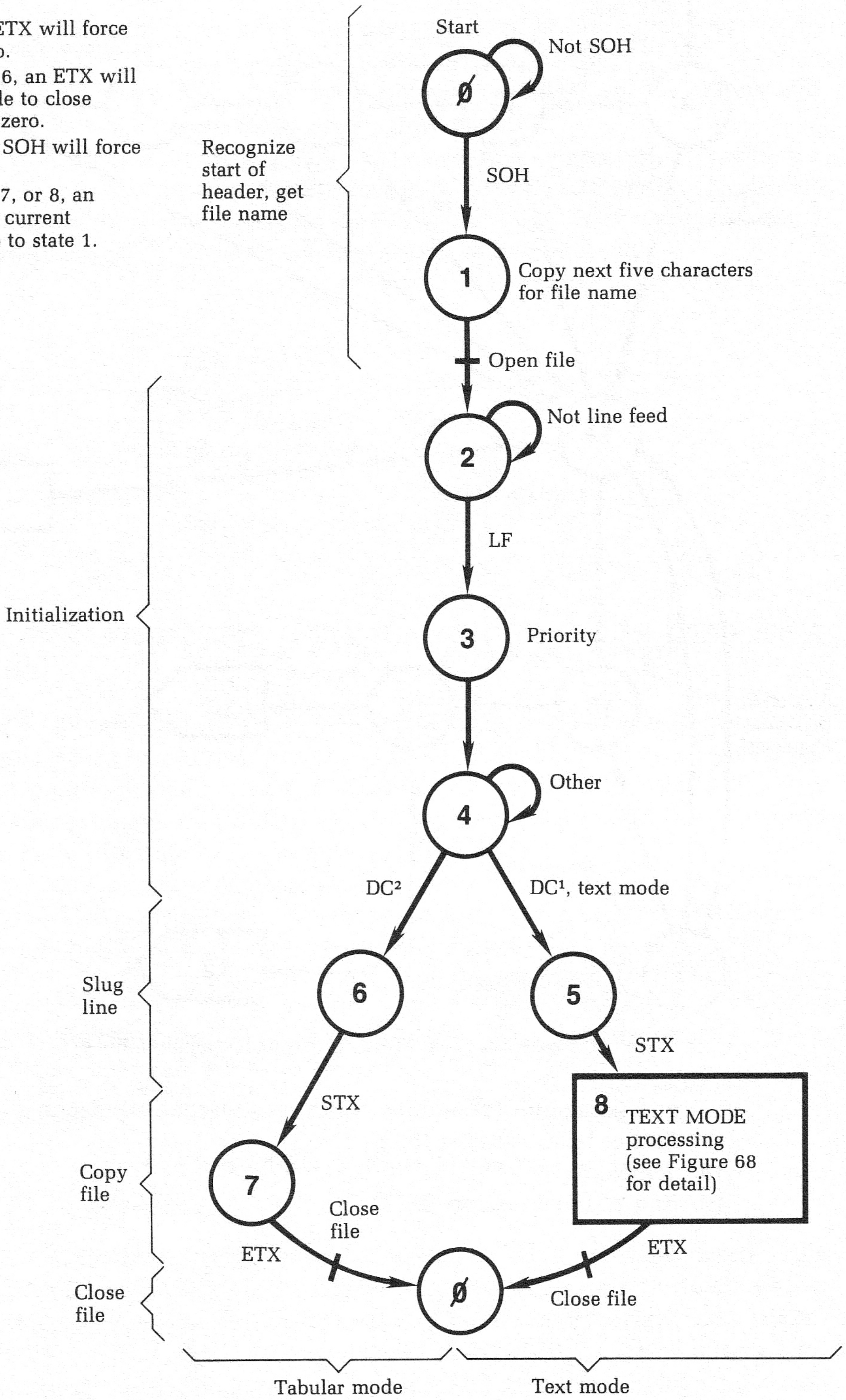

Recognize start of header, get file name
Start
Not SOH
0
SOH
1
Copy next five characters for file name
Open file
Not line feed
2
LF
Initialization
3
Priority
Other
4
DC^2
DC^1, text mode
Slug line
6
5
STX
STX
8
TEXT MODE processing (see Figure 68 for detail)
Copy file
7
Close file
ETX
ETX
Close file
0
Close file
Tabular mode
Text mode

Figure 67. Wire Stripping Algorithm (8-level)

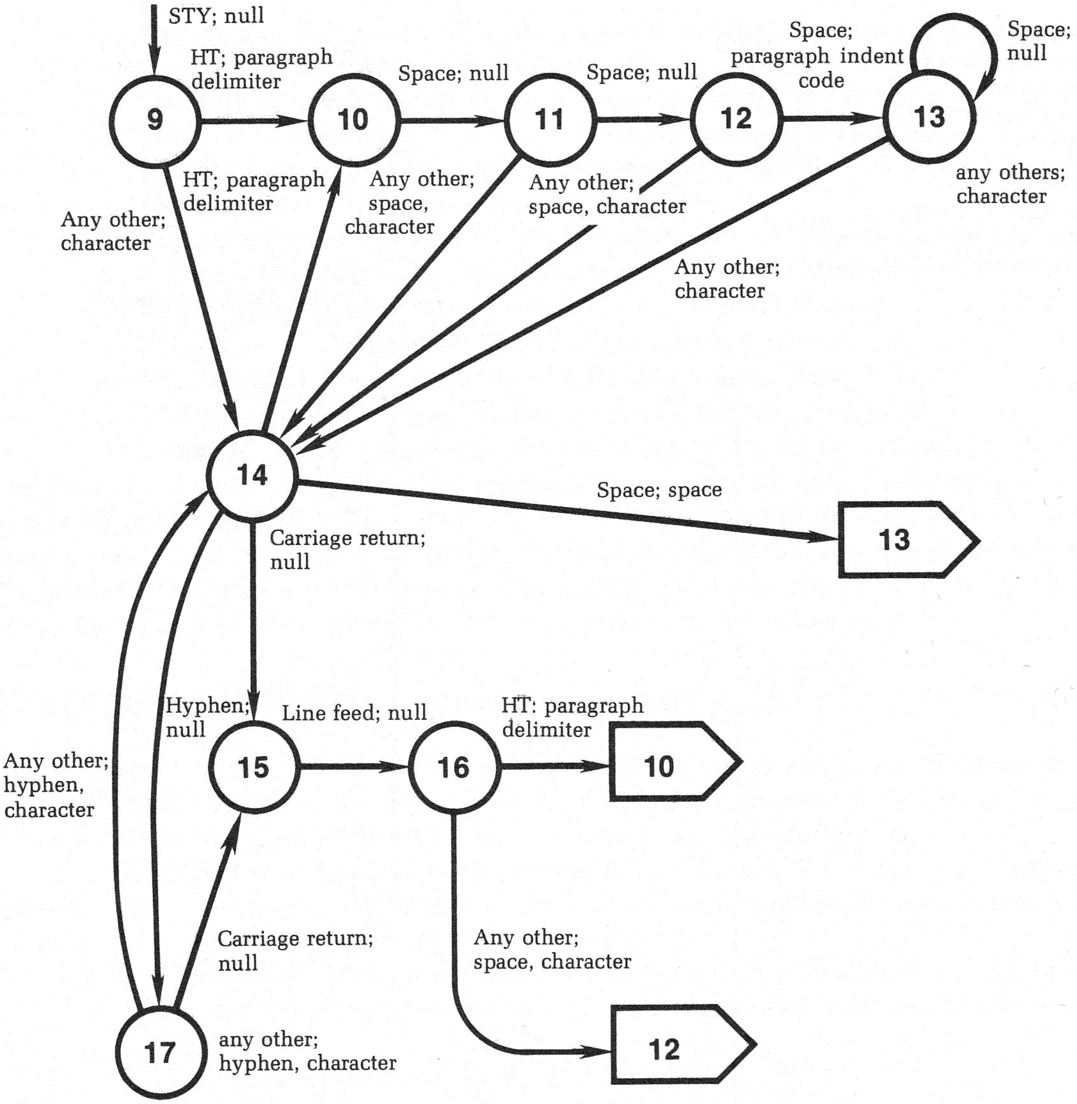

STY; null
HT; paragraph delimiter
Space; null
Space; null
Space; paragraph indent code
Space; null
9
10
11
12
13
HT; paragraph delimiter
Any other; space, character
Any other; space, character
any others; character
Any other; character
Any other; character
14
Space; space
13
Carriage return; null
Hyphen; null
Line feed; null
HT: paragraph delimiter
Any other; hyphen, character
15
16
10
Carriage return; null
Any other; space, character
17
any other; hyphen, character
12

Figure 68. Text Mode Processing (Detail of Figure 67).

and paragraph indentions are three consecutive spaces.

17. End of text character (ETX)
18. Time/date
19. End of transmission (EOT)

Any time that an SOH is received, the current file will be closed and the system will revert to state 1.

Any time a ETX is received, the current file will be closed and the system will revert to state O. A $\boxed{15}$symbol represents a connection to state 15.

Note: In this diagram, states are represented by circles with numbers inside; transitions between states are represented by arrows with the input, a semicolon, and the characters that are stored. For example, a transition from state 11 to 12 caused by receiving a linefeed which puts a carriage return line feed in the file would be drawn thusly:

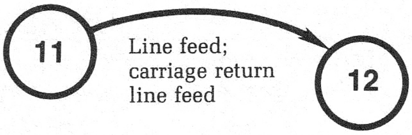


Figure 69. State and Transitions

5. TYPICAL HYPHENATION AND JUSTIFICATION ROUTINES USED BY A WIRE SERVICE

A. NOTES ON IMPLEMENTATION — presented in a programmer's shorthand without regard to grammar and punctuation. It's a bit cryptic, but that is the way a programmer would do it. It would be rewritten in order to become program documentation as discussed in Chapter 12. This example will serve to graphically illustrate the need for good documentation.

Internal representation of characters is what could be termed 'shifted six level TTS'. All 6-level characters can be translated into their internal representation by a simple 6-bit rotate right operation. (See Figure 70)

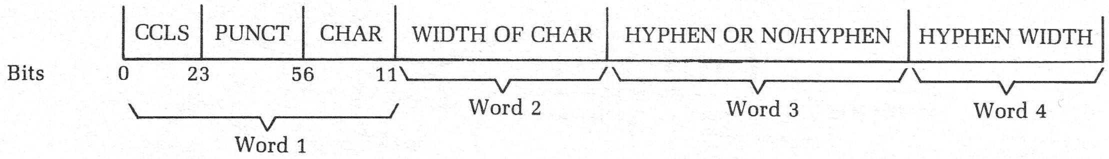
Six Level	Internal
P 54_8 = 1 0 1 1 0 0	0 1 0 1 1 0 = 26_8
Add Thin 11_8 0 0 1 0 0 1	1 0 0 1 0 0 = 44_8

Figure 70. 6-Bit Rotate Right Operation

A 6-bit class value for each character is listed in a table stored in the computer. The 6-bit value is considered as two 3-bit numbers; the left three bits are considered together as a group called 'PUNCT' while the right three bits are the value of 'CCLS'. 'PUNCT' contains parameters which the program uses for determining the hyphen point in a word. 'CCLS' contains character width information. The right-most bit in 'PUNCT' is the vowel bit (in the case of letters). All characters except 'special characters' ($, QL, QC, EM Dash, Hyphen, space band, elevate) are in 'CCLS' = 0.

The exception word dictionary is in packed ASCII (six bits per character, two characters per location), and is translated via table lookup when called in from the disk.

There is a hyphenation buffer of 260 (octal) locations, with four locations for each character; thus, the hyphenation buffer can handle text words of up to 54 (octal) characters. The arrangement of locations for each character is as follows:



Word 1 has the character in the right byte and the corresponding table entry of 'PUNCT' in bits 3-5.

Word 2 has the character width, as contained in the font table. Unit of measure is a relative unit based on 18 units/em.

Word 3 contains — 1 (7777) if this is an acceptable place for a hyphen. A zero if not.

Word 4 contains the width of a hyphen for this font.

Figure 71. Labels for Hyphenation Buffer

Hyphenation: All acceptable hyphens are placed in the hyphenation buffer, then the farthest right which will fit is selected for use. A dictionary search is first made for all words that need hyphenation. The letter 'Y' is considered to be a consonant except when specifically stated otherwise. The rules for hyphenation are:

1. All number sequences are allowed to be hyphenated following a comma.
2. Any hyphen, to be placed by the program, must obey the following rules:
    a. Not be placed closer than two letters from the beginning of a word.
    b. Not be placed closer than three letters from the end of a word. The end of a word is considered to be immediately prior to an ending 's'.
    c. No hyphen will be placed if there is an existing hyphen within one character of the calculated location.
3. No diphthongs such as SH, TH, PH, NG, CH, PR, GR, BR, DR, CL, PL, CK will ever be split, unless forced to be by the exception word dictionary. If a diphthong split is attempted, the tentative hyphen will be placed immediately preceding the diphthong, subject to the provisions of rule 2.
4. If there are four or less letters there will be no attempt to hyphenate.
5. If the first letters are: (V=vowel, C=consonant)

   a. VCC, then they are hyphenated VC-C., subject to rules 2 and 3.
   b. CVCC, then they are hyphenated CVC-C, subject to rules 2 and 3.

6. If the last letters are:
   a. CVCC, if V is an I, it will be hyphenated C-ICC.
      if final C is a Y, it will be hyphenated CV-CY.
   b. VCVC, if VCAL, then the hyphenation will be VC-AL.
      if VCIC, then the hyphenation will be VC-IC.
      if VCED, then set a flag and do not hyphenate.
   c. CVVC, becomes -CVVC. In addition, any vowel group immediately preceding CVVC may also be hyphenated subject to rules 2 and 3 previously given.
   d. CCVC, if CCED, ED flag is set, no hyphenation.
   e. CVCV, check for VVCVCV, then VVC-VCV, subject to 2 and 3.
      check for CVCVCV, then CV-CVCV, subject to 2 and 3.
   f. CCCC, no hyphenation is attempted.
   g. VCCC, if VTRY, then V-TRY.
      if VCKY, then VC-KY.
   h. VVCC, no hyphenation is attempted.

An internal sequence rule is applied in all cases except CVVC (which causes it to be called earlier.)

The internal sequence rule starts a scan from the point where the terminal rule (rule 6) placed the hyphen. This routine looks for groupings of letters whose pattern is CV*C* and places a hyphen in front of this group. (-V* means V or VV or VVV . . . and C*means C or CC or CCC . . .) Hyphens located by this rule are still subject to rules 2 and 3.

As a final check for the hyphenation point, a syllable rule is applied to all words in the hyphenation buffer prior to executing the hyphenation routine. If the last letter of the word is 'E', and a hyphen has been placed in front of the 'E', it is removed. Hyphens preceding groups of consonants (no vowels or 'Y' since last hyphen) are not used to break the word. At this point, the last letter is considered the one immediately preceding final '-S,' '-ED', or '-KY' in '-CKY'.

A structured flow graph is now given for the preceding cryptic programmer notes on implementation. The flow graph is far easier to understand than the cryptic notes.

B. STRUCTURED FLOW GRAPH PROCEDURES LEVEL ONE.

```
IF ('word' has 4 or less characters)
        THEN (set no hyphen flag)
        ELSE (set up flags and pointers)
                IF ('word' is numerics)
                        THEN (insert hyphens following all commas)
                        ELSE (insert all hyphens found in exception word dictionary)
                (insert all hyphens found by beginning sequence algorithm —
                 see below)
                (insert all hyphens found by terminal sequence algorithm — see
                 below)
                (insert all hyphens found by internal sequence algorithm — see
                 below)
                (remove all hyphens not meeting syllable rules)
        (select rightmost hyphen which allows word to fit on current line)
        (remove all other hyphens)
        (put word part and hyphen on current line)
        (put unused word part on next line and account for space in running width
         total)
        Insert all hyphens found in exception dictionary
```

Note: The implementation of the dictionary search depends on the organization of the dictionary itself. A typical organization is to have twenty-six different files, one for each letter of the alphabet. If a word is in the 'A' file then its first letter is 'A' and there is no need to repetitively store the 'A' for all words in that file.

The search proceeds through the dictionary file until all letters in the dictionary entry match the corresponding letters in the word to be hyphenated. When this correspondence is found, all hyphens found in the dictionary entry are inserted into the word in the hyphenation buffer.

The dictionary entries are not usually complete words but may be word roots which can have a number of suffixes attached. If the hyphenation is different for different suffixes, these differences and the root should be stored with the exception word entries.

Utility routines must be available to allow for updating, correcting, and listing in the exception word dictionary.

Vowels are A,E,I,O,U. Y is not generally considered a vowel in this program. In cases where Y is to be considered as a vowel, it will be explicitly mentioned.

C. STRUCTURED FLOW GRAPH PROCEDURES LEVEL TWO.

(Insert Hyphens Found by Beginning Sequence Algorithm)

```
IF (the classes of the first three letters are VCC)
    THEN (move hyphenation pointer between 2nd and 3rd letters)
        (place a hyphen)
    ELSE
    IF (the classes of the first four letters are CVCC)
        THEN (move hyphenation pointer between 3rd and 4th letters)
            (place a hyphen)
        ELSE (null)
```

(Insert Hyphens Found by the Terminal Sequence Algorithms)

```
DO UNTIL (ED flag is clear)
    IF CASE (classes of last 4 characters)
        CASE (CVCC)
        IF (vowel = I)
            THEN (move hyphen pointer to left of I)
                (force a hyphen)
            ELSE
                IF (final consonant is Y)
                    THEN (move hyphen pointer between 2nd and 3rd
                         character)
                         (force a hyphen)
                    ELSE (null)
        CASE (VCVC)
            IF CASE (last two letters)
              CASE (AL)
                  (move hyphen pointer between 2nd and 3rd characters)
                  (force a hyphen)
              CASE (IC)
                  (move hyphen pointer between 2nd and 3rd characters)
                  (force a hyphen)
              CASE (ED)
                  (set ED flag)
                  (move 'last' pointer to left of E)
                  (internal pointer = last pointer)
              CASE (all others)
                  (null)
        CASE (CVVC)
            (move hyphen pointer to left of 4th character)
            (place a hyphen)
                IF (next character left is a vowel)
                    THEN
                        DO UNTIL (next character to left is not a vowel)
                                 (move hyphen pointer left 1 character)
                                 (place a hyphen)
                    ELSE (null)
              CASE (CCVC)
                  IF (last 2 characters are ED)
                      THEN (set ED flag)
                           (move 'last' pointer to left of ED)
                           (internal pointer = last pointer)
                      ELSE (null)
              CASE (CVCV)
                  IF (next 2 characters to left are vowels)
```

```
                        THEN (move hyphen pointer between 3rd and 4th charac-
                              ters)
                              (place a hyphen)
                        ELSE
                        IF (next 2 characters are consonant, vowel)
                              THEN (move hyphen pointer between 4th and 5th
                                    characters)
                                    (place a hyphen)
                              ELSE (null)
        CASE (CCCC)
              (null)
        CASE (VCCC)
              IF (last 3 characters are TRY)
                    THEN (move hyphen pointer between 3rd and 4th
                          characters)
                          (force a hyphen)
                          ELSE
                                IF (last 3 characters are CKY)
                                      THEN (move hyphen pointer between 2nd
                                            and
                                            3rd character)
                                            (force a hyphen)
                                      ELSE (null)
        CASE (all others)
              (null)
```

(Insert All Hyphens Found by the Internal Sequence Rules)

```
DO UNTIL (exit flag is set)
    IF CASE (next character to left of internal pointer)
        CASE (vowel)
            (move internal pointer left 1 character)
        CASE (non-alphabetic character)
            (set exit flag)
        CASE (consonant)
            DO WHILE (next character to left of internal pointer is consonant)
                   (move internal pointer left 1 character)
            IF (next character to left of internal pointer is not a vowel)
                THEN (set exit flag)
                ELSE
                    DO WHILE (next character to left of internal pointer is a
                           vowel)
                           (move internal pointer left 1 character)
                    IF (character to left of internal pointer is not a consonant)
                        THEN (set exit flag)
                        ELSE (move hyphen pointer to left of consonant)
                            (place a hyphen)
    (remove all hyphens not meeting syllable rules)
IF (character to left of ‘last’ pointer is E)
    THEN
      IF (there is a hyphen in front of the E)
        THEN (remove the hyphen)
        ELSE (null)
    ELSE (null)
(hyphen pointer = last pointer)
    DO WHILE (hyphen pointer is within the word)
        DO UNTIL (hyphen pointer points to hyphen or past word)
               (move hyphen pointer left 1 character)
    IF (there are no vowels or ‘Y’ between hyphen pointer and ‘last’ pointer)
        THEN (delete hyphen at hyphen pointer)
        ELSE (‘last’ pointer = hyphen pointer)
```

(Select Rightmost Hyphen Which Allows Word to Fit on Current Line)

```
DO UNTIL (last pointer is at right end of word)
          (move last pointer right 1 character)
(hyphen pointer: = last pointer)
(clear exit flag)
DO UNTIL (exit flag is set)
     DO UNTIL (hyphen pointer points to hyphen) or (hyphen pointer is left of word start)
               (move hyphen pointer left 1 character)
     IF (hyphen pointer is left of word start)
          THEN (set exit flag)
               (set no hyphen flag)
          ELSE
               IF (part of word to left of hyphen pointer and hyphen will fit)
                       THEN (delete all other hyphens)
                            (set exit flag)
                            (set hyphen found flag)
                    ELSE (null)
```

D. STRUCTURED FLOW GRAPH PROCEDURES LEVEL THREE.

Note: There are two routines for inserting hyphens into a word in the hyphenation buffer: ‘place a hyphen’ and ‘force a hyphen’. Forcing a hyphen means unconditionally inserting a hyphen into the buffer. Placing a hyphen implies first checking to see that the proposed hyphen is not closer than two characters from the beginning or ‘end’ of the word, and not within one character of an existing hyphen.

(Place a Hyphen)

```
IF (hyphen pointer is closer than two characters to beginning pointer)
     THEN (null)
     ELSE
          IF (hyphen pointer is closer than two characters to 'last' pointer)
               THEN (null)
               ELSE
                    IF (there is a hyphen on the other side of the character on either
                       side of the hyphenation pointer)
                         THEN (null)
                         ELSE (force a hyphen at the hyphenation pointer)
```

E. STRUCTURED FLOW GRAPH PROCEDURES LEVEL FOUR.

(Force a Hyphen)

```
(insert a hyphen into the hyphenation buffer at the hyphen pointer)
(internal pointer =hyphen pointer)
(set hyphen found flag)
```

C. TYPESETTING TELEPHONE DIRECTORIES

The following section deals with the fundamental aspects of setting telephone directories. Setting directories is a task well-suited for computerized electronic systems since the amount of data (material) to store is large and the functions to be performed on the data are complex.

The telephone company has a very highly developed family of programs developed for project 'Direct'. These programs run on very large computers and involve data structures that are designed to enable the telephone company to obtain all kinds of statistics for operations in addition to that needed for the typesetting of the telephone books. If 'Direct' becomes a way of life for the telephone companies, the most advantageous method, from the telephone companies' point of view, for producing the directories would be to supply the printer with computer data which needs only to be set on a large typesetter. The control, manipulation, and processing of the data base would be done by the telephone companies.

The telephone companies could eliminate a great deal of duplicate effort by accelerating the process of developing appropriate standards to be used throughout the system.

1. WHITE PAGES

Setting white pages and daily addenda places requirements on the base structure that most present electronic systems cannot efficiently handle. These requirements primarily affect the:

1. File structure
2. Electronic file structure
3. Queue procedures
4. Storage management

In addition to the difficult requirements placed on the data base management aspects of the electronic system, there are also difficult requirements for:

1. Alphabetization
2. Duplicate books
3. Pagination
4. Abbreviations

The alphabetization computer program routines must be carefully written if they are to serve more than a few particular telephone companies. The requirements for non-domestic applications are, for the most part, completely different from the North American requirements. A truly international solution would be very complex and comprehensive.

2. YELLOW PAGES

The yellow pages of telephone directories offer the greater processing challenge, from the typographic point of view. The display ads are very similar to the grocery ads encountered in newspapers. One significant characteristic of this process is that usually more than half of the material is the same as in the last issue (last year's book).

A. DISPLAY ADVERTISEMENTS. The display ad has many characteristics which are akin to the grocery ad in the newspaper; however, there are some significant differences. One ad may appear in more than one classification within a book and in a multiplicity of books. The same ad entry may be billed to different customers for different books. Display advertisement needs call for:

1. Complex typography
2. Large storage requirements
3. Difficult file structures
4. Complex addressing schemes (electronic directories), and
5. Storage of artwork

These are areas where display advertising challenges the capabilities of electronic systems.

B. INCOLUMN ADVERTISEMENTS. The incolumn material has all the complexity of the white pages listings with additional requirements of:

1. Complex typography
2. Cross-correlation-incolumn to display
3. Abbreviations
4. Duplicate classifications and books
5. Line art considerations
6. Complex pagination requirements

The total electronic requirements for telephone directories are very stringent. The design of a total system for telephone directories is an extremely difficult task. It is complicated even further by the fact that standards and procedures differ from telephone company to telephone company.

CHAPTER NINE

INVESTMENT COST EFFECTIVENESS

A. INTRODUCTION

This section of the *Guide* will discuss the advantages of buying a system, point out the pitfalls of generating your own system, and give a rudimentary procedure for making a purchase decision. These preliminary discussions are followed by a detailed procedure that points out all of the considerations involved in making a purchase decision.

B. CONSIDERATIONS IN THE USE OF CAPITAL

An investment in a new system or in new equipment is made for many reasons: to increase the throughput of existing products and services; to diversify the product line and services; to compete more effectively; to acquire a bigger share of the market; to blend more harmoniously with other processes in the manufacturing cycle; to replace inefficient, outmoded equipment; to introduce new techniques which will be easier to staff because of their lower skill requirements; to appeal to the newer generation. Regardless of the reasons or demands that motivate change, it will undoubtedly require money to bring the change about. The expenditure of money or the investment of capital should be to protect and enhance the profit-making ability of the company. The maintenance of the financial strength of the company is necessary to secure and advance the livelihood of each employee and to generate a just return for the owners. One method of evaluating the success or failure of an investment is the long term profitability it will impart to the company.

When considering expenditure, or more specifically, investment in a typesetting system, the first matter to consider is the work that the typesetting system will have to produce.

The simplest demand is to produce a like quantity of a similar mix of work that is currently being produced. The categorization of work should be accomplished as suggested in Chapter 1. Having categorized the work, percentage volume can be calculated for each category and from that calculation the contribution to profit of each category can be determined. If work is accepted which currently cannot be set in-house, the value and contribution that this could make should be evaluated. After the types of work and their contribution have been established, the reason for change should be analyzed. It is usually not prudent to assume that a straight replacement of the current system is what should be done. Normally it would be very beneficial to change the scope of the system to include more complex work; such work generally commands a higher price and consequently, a greater profit margin. The typesetting process is sometimes considered unimportant compared to the subsequent process of the printing and binding; this is a danger. Diversification in typesetting should be contemplated with the goal of achieving greater profitability in the typesetting department, while still maintaining a 'balance' of processes in the company. The capital available to the company may be spent more advantageously in the areas other than the composing department, necessitating dispensing with the composing department altogether. A trend toward specialization has been evident for many years; specialization should be considered. If the current turn-around time offered to the customer is inadequate, an investment in an improved typesetting system should be considered. Normally an electronic typesetting system will improve the company's competitiveness and ability to penetrate existing or new markets. All these aspects and a few specialized ones should be considered in a formal investigation of the many different ways and methods now available for accomplishing electronic typesetting.

To simplify the comparison procedure, each typesetting work category should be weighed according to its potential profit contribution value. The following table shows three classifications that are generally found in the industry: simple text, simple display, complex mathematics. Note that the equivalent dollar value of display and mathematic work does not result in the same profit.

Table 10. Profit Contribution

Description	**Price Per Page**	**% Profit**	**Pages Per Hour**	**Contribution (Profit Per Hour)**	**Contribution Factor**
Simple Text	$10	5%	6	$3	1
Simple Display	$20	8%	2	$3.20	1.06
Complex Math	$40	15%	1	$6	2

When calculating the contribution of the various categories of work, it should be remembered that volume is also important. Irrespective of the unit contribution, if a sufficient volume is not achieved to justify the expenditure, then profitability is negative, unless of course the expenditure can be dispersed over several categories.

The next stage of evaluation can take place only after the following things have been established:

1. The categories
2. The percentage of each category in the total volume
3. The contribution of each category

Samples representing each category should be reproduced and evaluated as shown in Chapter 1. The cost effectiveness of each system for each category of work must be ascertained. It is important that all of the considerations mentioned in this chapter be investigated and quantified. The cost of various input systems, the type of work they can produce most effectively, and the profit contribution they can make must be determined. If the contribution does not equal or surpass the expenditure, the investment can only be justified by increasing the volume. If only simple work is to be produced on more capable systems, it will sometimes lead to a reduction in profitability due to partial utilization of the full capabilities (and cost) of the system. The system should not be grossly over specified for the categories of work it is to perform. The mix of work required should be capable of being produced by the system. One alternative would be to purchase a simpler system capable of dealing with the bulk of work produced and have the complex work set elsewhere. The other alternative would be to produce the complex work no matter how inefficiently. The second alternative is viable only if sufficient capacity exists on the system and at least a part of the departmental overhead can be absorbed.

The general conclusion is that the system with the greatest capabilities, consistent with profitability, should be considered. This is because:

1. More complex, specialized work, which normally is more profitable, can be undertaken.
2. The widest spectrum of work can be set.
3. Better alternative or back-up procedures are generally available on the more capable systems.

The worst possible approach is to put a lot of time, money and effort into an area which is highly specialized but has an insufficiently sized market. The net result is nearly always undesirable unless a dominant position in the market can be obtained.

The categories defined in Chapter 1 are offered as guides on how to apply the above theories when selecting a system. These guides should be modified or eliminated as necessary.

C. ELECTRONIC COMPOSITION INVESTMENT CONSIDERATIONS

1. GENERAL ASPECTS

A good general approach is to categorize your work, determine each category's percentage of your business, and the associated expense. Then determine the savings the system will provide in each category. Don't be surprised if you spend an inordinate amount of money on a small percentage of your work that will not be affected by the system. In general, the less complex your typography requirements, the easier it is to specify a system. The more difficult your typography requirements, the more difficult it is to specify your system.

Generally, there is little to be gained by attempting to have the vendor aid with your internal cost justification efforts. The vendor does not specifically understand or care about your business — he wants to sell you his system. You will have to be your own judge in these areas, and carefully evaluate whatever help the vendor can and will provide.

Never buy a system based purely on the vendor's specifications. Always write your own specifications. There are always considerations which make your requirements different from anyone else's. It may amaze you how many people in your company can make a real contribution to the selection process. The vendor knows his system's specifications and he may be drawing you onto disadvantageous ground if you just accept his information without question. However, having the vendor help *you* write your specifications will be better than merely accepting vendor specifications on their own. Beware of the fine print and technical language in a legal contract form.

Of all the systems sold to date, probably no two are exactly alike. If a vendor could develop a 'standard' system for a reasonable cost, it might be used in some installations where the company can restructure itself to accommodate the standard. At this point, that approach seems at least a few years away.

This section of the *Guide* will give you an excellent basis upon which you can determine your own specifications and write them in a manner in which the vendor can understand them.

Unless you have a large organization and can afford a long development, perhaps you should avoid hiring programmers to 'build' a system for you. In the past, several publishing-printing firms have hired programmers to build systems for their needs. Usually the hired programmer has to learn what is needed and often stops when he has learned as much as he can 'program.' He then proceeds to produce 'his' system. This often takes a long time and sometimes, unbeknown to management, he fails to sufficiently document his work. Thus he becomes an indispensable part of the 'machinery' necessary to run the company. He often cannot work alone, so he hires an assistant or two. Because managing programmers is a difficult job even for a professional computer systems manager, this system developer usually works without direct management. Without any pre-established performance requirements, he usually works to his own standards. If some of the in-house-generated systems were compared to vendor-generated systems, on a cost to performance basis, they might come out as a low second. A great deal of sympathy is held for the management that let the programmer do it himself. This system now is an indispensable part of the company and the programmer has everything in his 'head' about the system operation. That programmer has, perhaps, the ultimate in job security and can request and often get 'cost of living' raises almost whenever he pleases.

Often these in-house systems only attack a fraction of the work they could be doing if they had been properly designed. To design a system properly usually takes the combined team effort of experts from many areas. Most in-house systems were designed and built without this team approach. Recently, many who have in-house systems have begun to buy commercially-available systems. This is tantamount to saying, "The system we researched and developed is not as good as system *X*."

Many companies in the graphic arts are not in a position to evaluate a proposed system on a value-per-money basis. If one pays for a one-ton truck, one expects to receive a one-ton truck not a bicycle; even though the bicycle works very well. Sometimes an electronic system that 'works' like a bicycle is heralded as a success even though it costs as much as a one-ton truck, and has multiplied the manual labor rather than reduced it.

Of all the areas in industry that have been computerized, perhaps typesetting is the area in which the rewards are the greatest. The rewards that can come with the system are well worth the effort needed to obtain the proper system.

A. COST JUSTIFICATION. Determining the cost justification for the system is a very burdensome task; yet, it can yield to systematic analysis. An important thing to remember is that the state of the art is evolving so fast that the life of the system should be considered to be no longer than five years. If the system will not pay off in five years, the value of the system should be questioned in great detail. It is felt that the system should pay itself off in a three-year period.

The basic purpose of the system is to save labor and reduce operating costs. Other purposes which can be met are keeping or returning control of operational work phases to management.

A detailed study must be performed on the present operations to determine labor and material cost allocations in the areas of:

1. Input
2. Compare-Correct
3. Edit
4. Compose
5. Correct
6. Paste Up

Now a determination of cost savings provided by an electronic system can begin by placing the material to be set into the following previously defined categories:

1. Simple Text
2. Complex Text
3. Simple Display
4. Complex Display
5. Tabular Setting
6. Simple Mathematics
7. Complex Mathematics
8. Simple Chemical Formula
9. Complex Chemical Formula
10. Area Make-Up
11. Page Make-Up (Pagination)

The cost savings that can be obtained in each classification should be determined. The more capable the system, as has been previously stated, the more likely will be the reduction of costs in the complex classification.

In addition to composing functions, the system can reduce overhead costs such as those associated with moving paper around. The system ideally should not only 'set the type' but produce statistics and perform labor saving checking and accounting operations. These cost savings are more difficult to calculate than those in direct copy preparation and perhaps should be left out in the justification figures.

Once the existing production costs are determined, the costs 'with use of the system' can be projected. It might be a good idea to develop concrete typical work category examples and use them as a basis for a financial model. With these examples, keystroke numbers can be succinctly counted. Next, the rate at which the keystrokes can be entered must be determined. A cautious approach is to calculate the keystrokes per hour with a VDT terminal on the same time basis as that for a perforator. Admittedly, 'typing' on a VDT terminal is easier than typing on the mechanical keyboard, but in practice, the rates sometimes come out surprisingly the same. The ability of the system to have user-defined formats with nesting and chaining ability can greatly reduce the number of keystrokes and related operating costs required to set complex material.

If the system has a good visual composition capability, the costs for corrections will reduce but they will never become zero.

2. SIMPLIFIED EQUIPMENT SELECTION FLOW GRAPH PROCEDURE

This selection deals with the generalities of the equipment selection process and illustrates the major concerns and decisions involved. It also provides the basis for understanding the detailed equipment selection procedures.

Ten steps for system selection are given below:

1. Categorize the work performed into eleven or fewer categories, as defined in Chapter 1, 'Input Considerations — Type of Work Defined.' The categories are restated below:
    a. Simple Text
    b. Complex Text
    c. Simple Display
    d. Complex Display
    e. Tabular
    f. Mathematics Simple
    g. Mathematics Complex
    h. Chemical Formula Simple
    i. Chemical Formula Complex
    j. Area Make-Up
    k. Page Make-Up

   Once the categories are determined, samples of the raw, marked-up, input, edited, and set copy are made for each determined category. The samples of the raw and marked-up (as per house standards) copy for the different categories are sent to the systems vendors to be marked up (as per system standards) and set. The vendors should produce time estimates, total number of keystrokes, and the set material.
2. Determine your present work load in each category.
3. Determine a projected work load in each category.
4. Obtain from the interested vendors the system configurations, system costs, estimates of keystrokes and time, and the set material in each category.
5. Determine the total amount of net profit the system can generate for your present categories of work mix. Do not rely solely on the vendor data; use your own judgment.
6. Determine the total amount of net profit the system can generate for your projected categories of work mix.
7. Determine if you have the capital or can raise the capital on a satisfactory basis

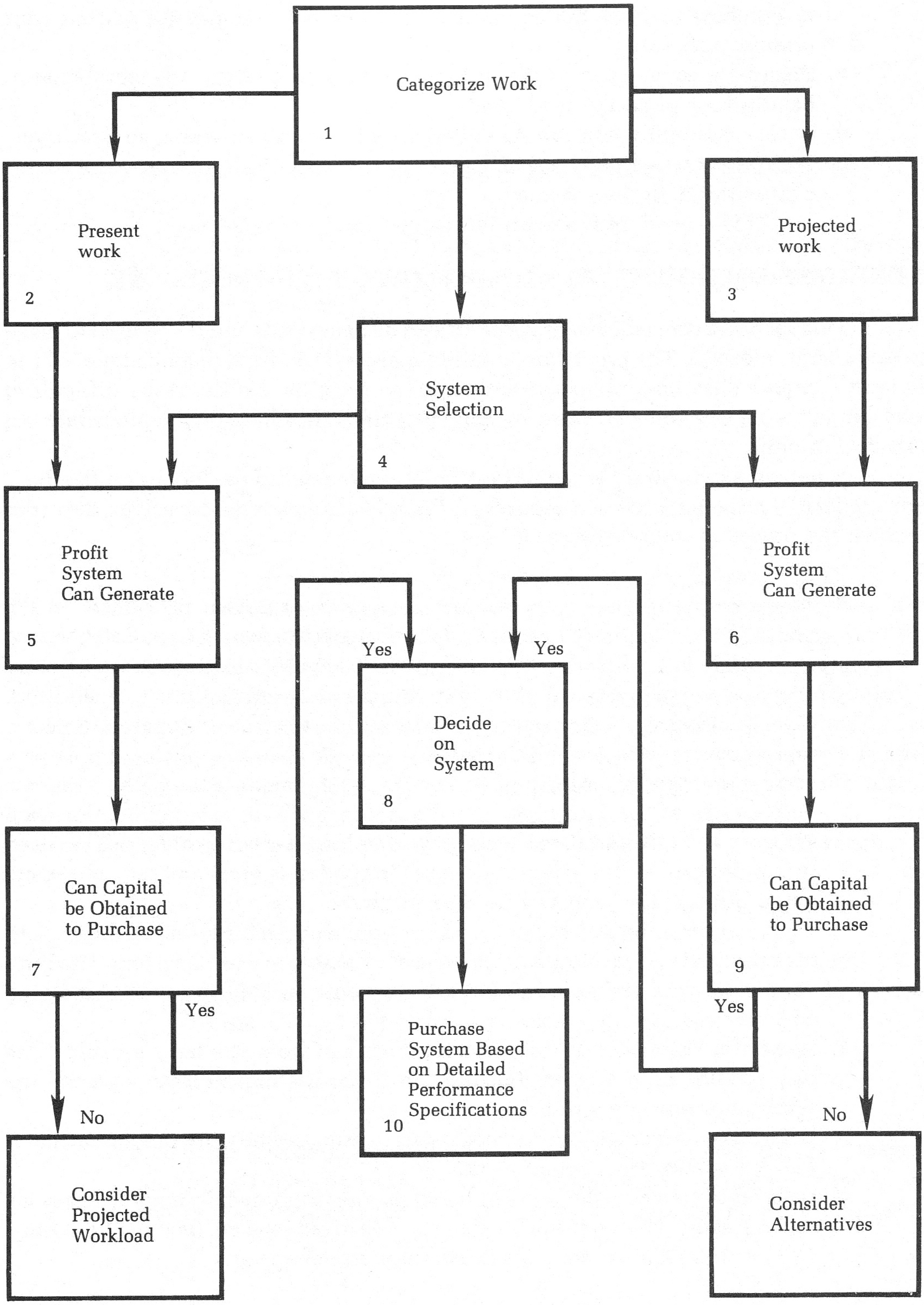

Categorize Work
1
Present work
2
Projected work
3
System Selection
4
Profit System Can Generate
5
Profit System Can Generate
6
Yes
Yes
Decide on System
8
Can Capital be Obtained to Purchase
7
Can Capital be Obtained to Purchase
9
Yes
Yes
Purchase System Based on Detailed Performance Specifications
10
No
No
Consider Projected Workload
Consider Alternatives

Figure 72. Ten Simplified Steps to a System Decision

to purchase or lease the equipment that will make money for you on your present work mix.

8. Determine (same as in 7) if you have the capital to obtain the equipment to handle your projected work load.
9. Decide (assuming you can do either) which system you desire to purchase.
10. Generate detailed purchase and performance specifications and write a contract with the desired vendor.

This procedure is shown in diagram form in Figure 72.

3. DETAILED EQUIPMENT SELECTION FLOW GRAPH PROCEDURE

This section details the major methods and decisions that should be used to make the equipment selection. The procedure is valid for any system from a stand alone VDT to the most complex electronic system. Admittedly, some of the decisions are difficult to make, but knowing what the decisions are and what effect they have on the procedure is a great deal of help.

A note of explanation — the following numbers refer to the blocks on the diagrammed detail equipment selection procedure, Figure 73, and not necessarily to the order in which the procedure must be accomplished.

Thirty detailed steps to equipment selection are:

1. Begin by grouping your work into categories as shown previously in the simplified procedure. Generate or delete categories if you desire. Categorizing your work will call your attention to where the profit margins are the greatest, and give you a great deal of insight into the electronic system's capabilities. Categorizing might also point out some areas that need attention. Select a representative sample in each category; include all the steps the sample progresses through including how it is finally set. From these samples, reproduce only copies of the raw copy and the house mark-up instructions for each category and transmit these to potential vendors. If several categories are used in the procedure, the insight into what is needed is great and may eliminate going through the process a number of times.

   Certainly, if a vendor cannot set your work in the form you desire with his proposed system, how can you expect to be able to use his system? Having a vendor set your example in each category will provide you with something concrete you can understand and relate to.
2. Determine the market price for each category of work you have utilized. This may require a little effort, but the better it is done, the more accurate the selection procedure will be.
3. Determine your gross (fully loaded) costs to produce the work in each category. Use extractions from actual work.
4. Determine your actual total volume. Break the total down into percentages for each category. Divide the percentage by 100 to obtain a decimal fraction, thus, 10% = .1, 20% = .2, etc., See illustration on next page.

Categories	**%/100**	
1	.1	
2	.32	These numbers are only illustrative
3	.4	
4	.1	
etc.	xx	xx = total which should add up to one

5. Make systems selection tables in ascending order of capability as illustrated below. For example, System 1 can set categories 1 and 2; System 2 can set categories 1, 2, and 3.

Work Categories			
1			
2	System 1		
3		System 2	
4			
5			System 3
etc.			

OCR-based systems are very capable in the simpler categories. VDT-based systems have the best capabilities in the more complex categories. VDT costs may make these systems not competitive in the simpler categories of work. Intelligent stand-alone VDTs can cover a large range of categories.

6. Construct a difference table of the market price minus your gross costs for each category of work. Do not be surprised if you discover some categories different from what they might be expected to be. An illustration is shown below.

Work Categories	**Market Price**	**Costs**	**Difference**
1	xx	yy	+zz
2	xx	yy	−zz
3	xx	yy	+zz
4	xx	yy	.zz
etc.			

xx, yy and zz represent actual numbers.

7. Construct a Rating Table by taking the difference in each category from the preceding table, and multiply by the corresponding decimal fraction for each category, as illustrated below. (The numbers are not actual—only illustrative.)

Categories	Decimal	Profit	Product
1	.1x(+ 22)	= +	+ .22
2	.32 x(− 22)	= −	− .704
3	.40 x(+ 22)	= +	+ .880
4	.1 x(+ 22)	= +	+ .22

8. Score the table generated in step 7. To do this, add up all the products (numbers) produced by multiplying the profit or loss (positive = profit, negative = loss) for each category by the decimal fraction of the total volume that the category represents.

   At this point, for your present methods, you can see which categories are most profitable and which are least. You might desire to obtain more work in the profitable categories and phase out the unprofitable categories.
9. If a negative number is obtained in step 8, consider the following list:
   a. Perhaps you should change your category mix.
   b. Consider subcontracting certain (negative) categories.
   c. Consider replacing present methods with electronic systems.
   d. Consider the categories in which you need the most help.
10. If a positive number is obtained in step 8, you will have a feel for:
    a. Which are your most profitable categories.
    b. Which are your least profitable areas.
    c. Where to direct attention.
11. Obtain from potential vendors your category samples set on the vendor's system and the vendor's estimate on the time and the number of keystrokes it will take to set each sample. If the samples are not set correctly, then the manufacturer's estimates of time and keystrokes are obviously erroneous. If the vendor is not willing to set these category samples, be very cautious; maybe the vendor is trying to sell hoped-for achievements rather than actual capabilities.
12. Make judgments on the vendor-supplied keystroke and time data. Compare these times with those experienced in the plant. Modify the data as appropriate to determine the labor costs in each category.
13. Construct a table which compares the costs of producing each category of work with the different system; include all the costs: purchase/lease costs, maintenance costs, material costs, and operating costs. Express these costs on a per hour basis. Life of the system should be assumed to be five years or less. The tables should show the projected costs for the system to produce the work in each category.
14. Make a difference table for each system. Take the market price minus the costs (gross) for each category as was done in 6 above.
15. Rate and score the tables. Rate by multiplying all the category differences of 14 by the (%) decimal fraction for that category. Score the table by adding the results.
16. Drop those systems that showed a negative score in table 15. These are the systems that will not make a profit under the present work load. These systems

should be dropped unless the system procurement is made on a basis other than the profitability of the system with the present work load.

17. Keep systems with positive scores in 15. These have the potential of generating profits. Do not be surprised if a stand-alone intelligent VDT scores quite high if your work mix does not at all fall in the simplest work categories. Large systems have advantages in areas other than copy preparation. These areas include accounting and management information. A system should not be purchased on a basis other than what it will do for the copy preparation cycle. Some of these touted other advantages turn out to be phantoms when the installation is accomplished.
18. Project what the volume will be in the future and enter these volumes per category into a table similar to step 4. This is an exercise in futures.
19. Construct a difference table. This table will show the market price minus the costs for producing each category with the electronic system. Make rating tables by multiplying the values in the difference tables by the decimal fraction of the projected volumes for each category. This is similar to steps 6 and 7 except that decimal fractions of projected volumes are used.
20. Score the results of the tables produced in step 19 by multiplying the profits (or losses) in each category by the decimal fraction of volume for that category. Add the results for each category for each system.
21. Drop the systems which gained negative results from step 20. These systems will not produce a profit for the product (category) mix even at projected volumes.
22. Keep and consider the systems with a positive score from step 20.
23. Compute the total profit that can be obtained from systems that scored positive in step 22, by multiplying the projected gross volume (PGV) by 100 times the scores obtained in step 22. PGV x 100 x score = profit.
24. Compute the total profit that scored positive in step 17, by multiplying the actual gross volume (AGV) by 100 AGV times the scores obtained in step 17. AGV x 100 score = total profit.
25. and 26. Determine, with the net yearly profit from 24, how many years it will take for the profit on the investment to equal the investment cost. Do the same for projected profits and present profits. If a system is good under present conditions, and better under projected conditions, it will allow for future growth. Obviously the investment that will pay itself out in the fewest number of years is the best.

Now you are in a position to decide which systems are best for your present and projected operations.

27. Weigh a possible investment in electronic composition systems against other corporate decisions such as a new press, new building, etc.
28. Consider other models with different category mixes, etc., if the decision is not to invest at this time in an electronic composition system.
29. Write a detailed system specification and select a vendor if the decision was yes.

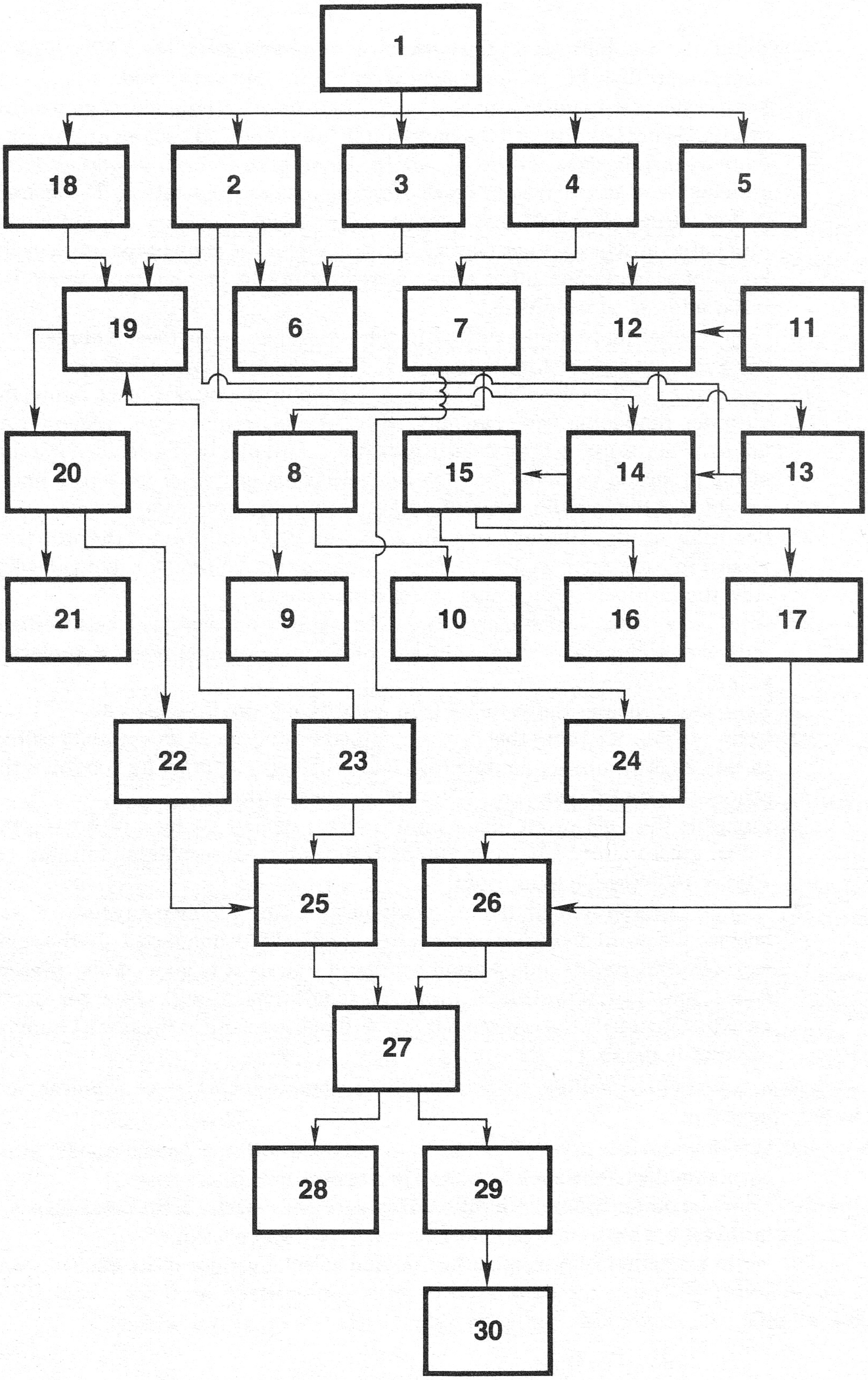

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Figure 73. Thirty Steps to System Decision

30. Write a contract which includes all the items of concern as discussed in other chapters of this *Guide.*

It may seem like a lot of work, but considering the results of some of the ad-hoc, ill-fated decisions that have been made in the past, the effort will be very worthwhile.

D. EVALUATION OF THE INVESTMENT DECISION

The decision to invest in capital expenditure is related directly to the time and type of expenditure, and the current financial position of the company. The decision usually implies a long term course of action which directs the company's policy for some time. The following comments are included in the *Guide* to refresh the memory of the reader and point out some of the implications of capital expenditures.

1. VALUE OF MONEY

Money is a commodity having a value which fluctuates with time. A dollar now, even in the worst of times, will buy more than a dollar 10 years from now. It follows that an important consideration in making an investment is when the money is to be paid out.

2. COST OF MONEY

The cost of money or capital varies considerably. It is not merely reflected in the current bank loan rate. Money can be obtained from many sources, all of which have their own cost advantages and disadvantages. A company or corporation can raise money from retained earnings, sale of stock, bonds, or bank loans. The cost of each dollar should be calculated and since the charges change, these costs should be periodically updated.

3. INVESTMENT COST AND CASH FLOW

If the capital expenditure represents a large proportion of the company's available cash, a detailed Cash Flow analysis must be made. The Cash Flow projection should highlight and identify the relative safety or risk of the expenditure from the cash available.

4. NET EARNINGS EFFECT

Nobody wants to negatively affect the net earnings per share, because this has an unsettling effect on stock holders and can affect the prices of stock. Although depreciation charges will reduce the outflow for taxes, taxes also reduce net earnings. The requirement is, therefore, to invest efficiently and yet conserve cash while enjoying 'stable and adequate growth'. Investment decisions must consider all alternatives. Renting, leasing and other deferred financing all have significant impact on the company's earnings and projections. The correct timing and interrelating of projects can help the company maintain a smooth development of growth and earnings.

5. CONTINUING COSTS

After the installation, certain costs will continue and will have to be evaluated. Software development, building overhead, additional personnel with new skills to maintain the equipment, and system upgrading will all have to be considered with respect to volume or capability changes. The changes will also reflect the results brought about by the original investment.

6. PROFIT

The 'profit' may be achieved in savings gained over the current method or it may accrue as a result of an increase in the profitable gross sales. Regardless of how the profit is achieved, the expenditure and running costs should be monitored several times over the life of the project.

7. TAXES

All taxes will affect profits. Import, export, sales, and income taxes must be included in any evaluation. The effect of taxes on depreciation, investment allowances and training grants should be considered. The geographic location and the time can greatly influence the calculation.

8. RESALE OR SALVAGE VALUE

The resale or salvage value can be assigned to the original value or, in the case of a trade in, to the new investment. Its influence on taxes also has to be considered.

9. FINANCIAL ALTERNATIVES

The procurement decision is related to a detailed cash flow analysis and a policy decision on the part of the company. Is risking of obsolescence within the planned life of the project possible? Is it preferable, from the company stand point, to view the expenditure as either an operating expense or a capital investment?

The most commonly used method of evaluating investments is the time required to obtain payback. This payback period is calculated on the time required to generate income or savings that equal the original expenditure. For example, a system costs $50,000 and is calculated to save $25,000 per annum, the payback period is two years. If an alternative system costs $75,000 and saves $25,000 per annum, the payback period is three years. With the payback logic, the first sample would be preferred since the period is shorter.

Unfortunately, this does not take into consideration profitability. The evaluation excludes other criteria or assumes them to be equal — a fallacy in both cases. Assume the first example has a life expectancy of three years and a trade-in value of $10,000. The second example has a life expectancy of five years and a trade in value of $20,000.

Table Eleven. Payback Table

Example	Initial Cost	Payoff Rate per Annum	Payoff Time	Life Expectancy	Contribution after Payback	Trade in Value	Gross Profit
1	$50,000	$25,000	2	3	$25,000	$10,000	$35,000
2	75,000	25,000	3	5	50,000	20,000	70,000

From this the following should be noted:

1. A fast payback often implies a minimum return from an investment.
2. If payback is the sole method of evaluation, many profitable investments will not be made.

To maximize profits, a company must invest the money or funds available into projects having a net return higher than the cost of capital to the company.

The longer the period of life for a project, the less accurate become the payback calculations. On a long-term project, many variables, such as cost of operation, labor savings, etc., will change. These variables should be looked at and evaluated periodically.

Tax and methods of financing, leasing, etc., must be included in the evaluation. These can radically affect the calculations, particularly on longer term projects.

10. AVERAGE RETURN ON INVESTMENT

For this method, the Average Return on Investment is calculated by dividing the total income by the life expectancy of the equipment. This gives the Average Contribution for each year of life for the equipment. To calculate the annual contribution as a percentage value, divide the Average Yearly Contribution by the total investment figure.

$$\frac{\text{Total Income}}{\text{Life Expectancy}} = \text{Average Per Annum Contribution}$$

$$\frac{\text{Average Per Annum Contribution}}{\text{Total Investment}} = \text{Annual Contribution \%}$$

1. If a \$10,000 investment will repay \$15,000 in 10 years and the calculated life expectancy of the equipment is 10 years, the Average Yearly Contribution is \$1500. The Average Yearly Contribution divided by the investment gives the Annual Contribution or Return on Investment of 15%.

   Example One:

   $$\frac{\$15{,}000 \text{ (total repayment)}}{10 \text{ (years)}} = \$1500 \text{ Per Annum Contribution}$$

   $$\frac{\$1500 \text{ (Per Annum Contribution)}}{\$10{,}000 \text{ (investment)}} = 15\% \text{ Annual Return on Investment}$$

2. If a \$10,000 investment will repay \$10,000 in one year and the calculated life expectancy of the equipment is one year, the Average Yearly Contribution is \$10,000. The Average Yearly Contribution divided by the investment gives the Annual Contribution or Return on Investment of 100%.

Example Two:

$$\frac{\$10{,}000 \text{ (Total Repayment)}}{1 \text{ (year)}} = \$10{,}000 \text{ Per Annum Contribution}$$

$$\frac{\$10{,}000 \text{ (Per Annum Contribution)}}{\$10{,}000 \text{ (Investment)}} = 100\% \text{ Annual Return on Investment}$$

3. If a $10,000 investment will repay $100,000 in 10 years and the calculated life expectancy of the equipment is 10 years, the Average Yearly Contribution is $10,000. The Average Yearly Contribution divided by the investment gives the Annual Contribution or Return on Investment of 100%.

Example Three:

$$\frac{\$100{,}000 \text{ (Total Repayment)}}{10 \text{ (years)}} = \$10{,}000 \text{ Per Annum Contribution}$$

$$\frac{\$10{,}000 \text{ (Per Annum Contribution)}}{\$10{,}000 \text{ (Investment)}} = 100\% \text{ Annual Return on Investment}$$

In example one, a reasonable return of 15% per annum is indicated. In example two, the return of 100% seems good, until it is realized that the profit is zero. Example three, also indicates 100% rate of return, but obviously contributes greater profits. The conclusion is that averaging the return does not truly represent the worth of an investment and favors short-term investment. The method has disadvantages similar to those of the payback logic, in that it ignores profitability. The cost of money, taxation, and the time element are not adequately covered.

11. DISCOUNTED CASH FLOW

This method requires more calculation than the previously mentioned techniques and also requires detailed estimates of future earnings to establish the cash flow. This method is sometimes frowned upon by managers who do not like to commit detailed, itemized figures to predictions. However, a start has to be made somewhere. In example one, the after-tax cash flow is shown assuming 20% depreciation per annum and a tax rate of 50%.

Table Twelve. Discounted Cash Flow

				A	B	C	D	E
						(A-B)	(50% C)	(B + D)
Year	**Investment Cost**	**Investment Credit @ 10%**	**Cash Outflow**	**Gross Income**	**Depreciation**	**Before-Tax Earnings**	**After-Tax Earnings**	**After Tax Cash Inflows**
0	$50,000	$5,000	$45,000					
1				$15,000	$10,000	$5,000	$2500	$12,500
2				15,000	10,000	5,000	2500	12,500
3				15,000	10,000	5,000	2500	12,500
4				15,000	10,000	5,000	2500	12,500
5				15,000	10,000	5,000	2500	12,500

Finding the rate of return on the investment is an iterative procedure to ascertain the point at which the net cash inflow equates to the current net cash outflow. This calculation is assisted by using suitable present value tables.

Using selected factors from Present Value Tables, the following comparison table can be constructed.

Table Thirteen. Cash Inflow

		A	B	C	D	E
Year	**Cash Outflow**	**Cash Inflow**	**10% Present Value Factor**	**Present Value @ 20% (A x B)**	**5.8% Present Value Factor**	**Present Value 12% (A x D)**
0	$45,000		1.0000		1.0000	
1		$12,500	.8333	$10,416	.8928	$11,160
2		12.500	.6944	8,680	.7972	9,965
3		12,500	.5787	7,234	.7118	8,897
4		12,500	.4822	6,027	.6356	7,944
5		12,500	.4019	5,023	.5674	7,092
		62,500		$37,380		$45,058

Table thirteen shows that the present value of the net cash inflow at 20% is $37,380. That is less than the cash outflow of $45,000. With 12%, a return is produced of $45,058, coincident with the outflow. The discount return on investment is therefore 12%.

The information shows that:

1. A net cash outflow of $45,000 will produce a net cash inflow of $62,500 over a period of 5 years.
2. To achieve this, $45,000 must be invested. If the cost of money exceeds 12%, then the investment loses its attraction. If the cost of money is lower than 12%, the investment is attractive.

This method is advantageous because:

1. The profitability factor over the time is considered for the life of the project.
2. An account is made for taxes, depreciation, the cost of money over a time period.
3. Alternative financing methods can be considered.

There are disadvantages because:

1. It assumes money generated will be immediately invested.
2. The method necessitates a lot of work compared to the simpler techniques.

12. NET PRESENT VALUE (NPV) METHOD

The NPV is similar to the Discounted Cash Flow, in that the life of the project is documented with respect to cash flow and return. A rate is calculated representing the cost of capital to the company over the life of the project.

In principle, if the net present value is positive, the investment is beneficial to the firm. If NPV is negative, the investment is not contributing to the cash inflow and is detrimental to the company and should not be undertaken.

As an example, to calculate the NPV for a system that will cost $200,000, the following example is indicative of the steps that have to be followed.

First, the basic data has to be assembled on the current and predicted investment tax rate, income tax rate, and the cost of capital. The life expectancy of the equipment, the available hours, and utilization should be projected and calculated. The equipment hourly cost rate, the equipment overhead cost, the operator hourly cost rate, and any other predictable income or expenses which will be incurred, should be noted. Income normally includes the salvage value and expenses include major overhauls, refits or capital additions to the equipment.

The basic data must be gathered as follows:
5% Investment Tax Credit
50% Income Tax Rate
10% Cost of Capital
5-Year Depreciation (n)
$100 Per Hour Income When Working
60% Utilization
2 Shifts Operating 6 Days a Week, 48 Weeks a Year
$10 Per Hour Operator Cost and Fringe Benefits
$250 Overhead Cost, Maintenance, Space, Utilities, etc.
$10,000 Third Year Refit Overhaul
$20,000 Salvage Value

From this Basic Data a detailed outline for the Estimated Utilization Per Annum can be calculated.

16	Hour/Day
x .6	Utilization
=9.6	Hours/Day
x 6	Days/Week
=57.6	Hour/Week
x 48	
=2764.8	Hours/Year

Estimated Gross Income and Expenses Per Annum

Similarly, the Estimated Gross Income and Expenses per annum can be calculated using the appropriate information from the Basic Data.

Income

2764.8 Hours/Year
x $100 Per Hour
=$276,480 Per Year

Expenses

32 Operator Hours/Day (4 people on split to 2 shifts)
x6 Days/Week
=182 Hours Per Week
x$10 Operator Hourly Cost Rate
=$1820 Per Week
x48 Weeks/Year
=$87,360 Per Year
+$72,000 Overhead ($250/day x 6 days x 48 weeks
=$159,360 Normal Annual Operating Expense

Estimated Gross Profit Per Annum

From the calculated Estimate for the Gross Income and Expenses the Estimated Gross Profit can be calculated.

$276,480 Gross Income (Annual/Estimated)
−159,360 Gross Expense (Annual/Estimated)
=$117,120 Gross Return
(Annual/Estimated)

Investment Tax Credit

From the Basic Data the Investment Tax Credit can be calculated.

$200,000 Purchase Price
x .05 Rate for Investment Credit
=$10,000

Depreciation

To calculate the depreciation, the following procedure should be adopted. For the first year, the depreciation change is calculated as follows, n = life over which the investment is depreciated:

$$\frac{2\ (\text{Cost} - \text{Salvage})}{n+1} = \frac{2\ (\$200{,}000 - \$20{,}000)}{6} = \$60{,}000$$

The second year of depreciation change is calculated as follows:

$$\text{Previous year's depreciation} - \frac{2\ (\text{cost} - \text{salvage})}{n+2}$$

$$\$60{,}000 - \frac{2\ (\$200{,}000 - \$20{,}000)}{7} = \$8571.43$$

The above step is repeated until the total life expectancy of the equipment is covered. Each year n is increased by one. Thus for the third year, n+3 is the denominator. Using this formula the depreciation schedule is as follows:

Table Fourteen. Investment Cash Flow

Year	Previous Years Depreciation	$\frac{2\ (\text{Cost} - \text{Salvage})}{(n+1)}$	Depreciation Last Year
1			$60,000
2	$60,000		48,000
3	48,000	$12,000	36,000
4	36,000	12,000	24,000
5	24,000	12,000	12,000

Using the calculated information and the basic data, cash flow for the investment can be calculated. The same Present Value Table is used to generate the above example.

The most significant factor emerging is the quantifying of the cost of money to the company. Although the work entailed is long and detailed, the result allows much more rational management judgments to be made and results in a lot clearer picture of the effects of investments on the company.

Chapter Ten

GENERAL SYSTEM ARCHITECTURE

The following comments are not intended to be a computer scientist's approach to the system architecture but rather a pragmatic look at the system from the printer's point of view. These comments apply to stand-alone VDTs as well as to the large all 'singing and dancing' real-time systems.

The system should be designed to have the following properties:

1. Input keystroke minimization
2. Ease of keystroking
3. Unlimited editorial capabilities
4. Sufficient typographical capabilities
5. Ability to impart to the human eye an image which will allow the final typesetter output to be easily envisioned
6. Ability to allow corrections at any stage in the copy preparation cycle
7. Ability to set the type in as near to page form as is financially sound

A. INPUT KEYSTROKE MINIMIZATION

In straight matter almost any keyboard is the same as another. If all the printed signs in the material are approximately 86 in number, OCR may be a good approach. If the number of different signs exceeds 86, precedence codes (flag codes) must, with their attendant complexities, be resorted to. In general, the originating keyboard should put the keystrokes into electronic form as soon as possible so the material can then be computer processed, stored, transmitted, etc.

An input keyboard should have a sufficient number of keys to allow pi entry, etc., without undue complexity. The original designs for some hot metal machines had different keyboards for different fonts. These keyboards occupied large areas and required a great deal of operator acclimation. The need for multiple keyboards can be eliminated with the use of shift keys which could be used to change the font.

Typing schools, in general, teach entry on the American Standard typewriter keyboard layout. That layout is a good place to start, but obviously, additional keys would be desirable.

B. EASE OF KEYSTROKING

In general, most typists can only keep so many key positions and meanings in their memory; this sets a bound on the number of keys. If an entry requires the typist to stop and think, speed is greatly reduced.

Programmable key code explosion is possible on intelligent VDTs. This can greatly reduce the difficulty of input keying, particularly in the case of complex material.

If the VDT can justify and hyphenate as the material is keyed, great advantages can often be obtained because the material can be entered in 'correct' form.

C. UNLIMITED EDITORIAL CAPABILITIES

With keyboards and key functions almost universally standardized, the science of VDT editing seems to have reached a plateau of achievement. This however is not the case. Many new keys and new functions are still forthcoming. The CRT screen could be used to aid the operator by displaying the meanings of the keys in the different shift modes. This could be accomplished by a key labeled display keyboard layout (DIS/KB). Depression of this key would cause a keyboard layout to appear on the screen showing the meanings of the keys for a given level of shift. The important thing is to insure that the system or stand-alone VDT has the ability to give you the level of editing capabilities you need.

Most systems have bounds on the size of copy block that can be handled in one take. Make certain that block size does not force you to break up your natural blocks into pieces which must be put together. The required editing, more often than not, will occur at the block boundaries and that will be a problem. Ability to scroll the material on the VDT screen is far more useful than the ability to look at it one VDT page at a time.

D. SUFFICIENT TYPOGRAPHY CAPABILITIES

This is a general consideration which simply means: can the system (simple or complex) set type in all the forms you require, i.e., tabular, ragged, skewed? Some very complex programming is often required to perform complex functions which when performed by program, sometimes do not meet human standards. In general, it is a good idea to request only the typography you need and let someone else discover the bugs in the complex programs. Often the complex task can be accomplished with better results by using combinations of simpler functions.

E. EYE IMAGE

This is a very important consideration. If material is specified as tabular, it should be shown on the VDT screen in essentially tabular form. If it is indented, the screen material should be indented. A VDT display that shows merely a serial stringing of typesetter drive codes that exist on a paper tape is of little value and is certainly not state of the VDT development art. Different size character representations on the VDT are desirable to see copy fit; so far these VDTs are very costly. With the cost reductions in solid state memory, this should not remain true for long. It should also be possible to present different fonts on the VDT screen.

Ideally, the eye should be able to see the material on the VDT in the exact form that it will come out of the typesetter. Obviously, the more closely the VDT can reach this goal the more worthwhile it is, especially for complex matter.

F. ALLOW CORRECTION AT ANY STAGE

An important consideration is the ability of the system to allow corrections at any stage. Most typography programs are structured so that everything passing through the computer CPU must pass through the hyphenation and justification programs — a great disaster in a lot of ways since this does not allow the human being to be the final judge of the correctness of the material. Computer programs have a long way to go in becoming as good as the human being in determining correctness of the typography.

Ideally, the correction loops shown in Figure 74 should be allowed in any system.

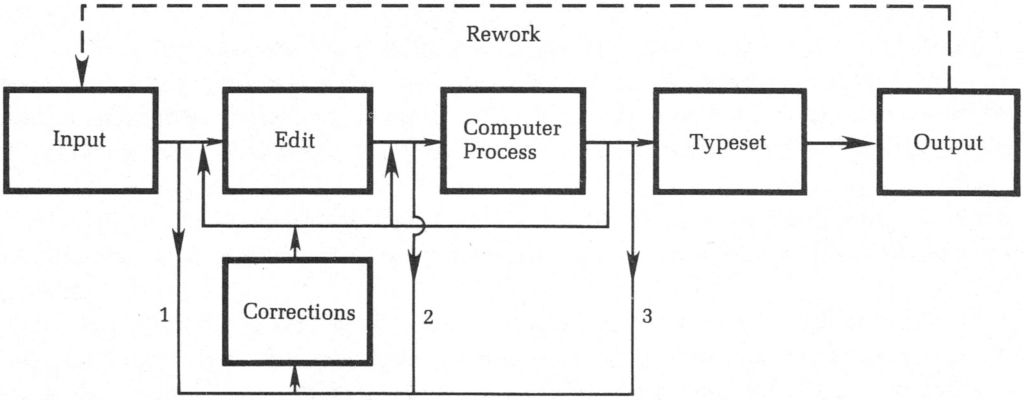

Figure 74. Ideal Correction Loops in an Electronic Typesetting System

Loops 1 and 2 exist in most systems. Loop 3 can save the most time, effort, and money.

In a stand-alone VDT, Loop 3 merely means that the output (typesetter) drive tape should be able to be read back into the input reader. In a complex system it means that a file that has been processed for typography can be called onto the screen.

Viewing of the material in hierarchical form is desirable.

If the electronic system does not provide for good editing and correction it has missed the goal of its creation.

Rework should be reduced or eliminated. This can best be done with a good electronic system.

G. SET TYPE IN PAGE FORM

Although there is a great deal of saving to be realized by eliminating or reducing paste up, it cannot, at present, be done efficiently by computer programs. No matter how large the computer the full page system utilizes, no matter how complex the programs are, they are going to be hard-pressed to do as good a job on varying page formats as can be done by the human being. All full-page efforts should place the human being in the copy preparation cycle rather than replace him with a computer program.

The value of a full-page system is directly related to the quality of the full-page display system which it provides. Such systems seem to be sorely lacking from the companies now supplying equipment to the printing and publishing industry.

CHAPTER ELEVEN

SITE PREPARATION

A. INTRODUCTION

The site preparation is a major consideration since it often involves a great deal of renovation of the physical plant and facilities. Modern computers do not require the expenses of huge air conditioners required by some of the earlier computers. Nevertheless, they work more reliably when the temperature and humidity are kept within reasonable limits.

The mere cabling together of all the components of the system can involve considerable work and investment. A false floor or a ducting scheme is usually a good approach.

An effort to make the computer room comfortable and aesthetically pleasing should be included in the renovation, since pleasant surroundings maximize personnel output. The computer room nowadays, perhaps even more so than the 'board room', is a prestige feature of the company.

The modern LSI (Large Scale Integration) circuits used for the modern computer and logic, impart excellent reliability without close temperature controls. The computer can generally be placed with the press equipment if that is what is desired; that would hardly be a way to maximize the investment.

However, this section of the *Guide* will give you a good indication of the costs and ways of preparing the site for your electronic composition system.

A decision about how much is to be spent on housing new equipment and systems should be based on thorough knowledge of specific needs. Lavish expenditure may bring little or no return; yet inadequate expenditure can result in excessive downtime and poor productivity. It is obvious that a balance should be achieved between expenditure and return. The principal points to consider are:

1. Power and Utility Services Requirements
2. Environmental Requirements
3. Productivity Requirements
4. Aesthetic Requirements

These four principal points overlap. Although stated as four separate points, they should always be considered together during department planning and site preparation, because they interact with each other.

B. PHYSICAL DIMENSIONS

Physical dimensions must first consider the size of the unit required. Included in this consideration should be:

1. Equipment requirements
2. Personnel requirements
3. Future expansion requirements

1. EQUIPMENT REQUIREMENTS

First prepare a list of the components to be used in the installation. The list should include all items, viz., storage cabinets, desks, work tables, lockers, conditioning plant for water or air, meters, spare parts, service equipment. Additional space is required for aisles and walkways for personnel and equipment.

2. PERSONNEL REQUIREMENTS

People require:

1. Working area
2. Washroom area
3. Walkways

The working area is determined by the type of work and equipment being used. Washroom facilities are determined by the number and sex of personnel. Walkways are specifically required for personnel.

3. FUTURE EXPANSION

Often it is advantageous to include an area in the original specification which will not be used immediately but for which a known need exists in the near future. Including this area results in:

1. Less cost for the additional area than a separate development
2. Minimum disruption of an existing area when the expansion takes place

The disadvantages are:

1. The additional cost has to be borne with no immediate return
2. The natural tendency of 'a given amount of work to expand to fill all available space'

The advantages and disadvantages should be weighed against the probability of future requirements to determine whether or not future expansion capability should be part of the present design.

Principal items of control should not be located on main walkways or traffic centers. The storage areas should not occupy prime access areas and should be arranged in order of use, leaving the least frequently used material farthest from the point of use. The space allocated to test equipment is not critical but should be adjacent to the main area. Backup equipment should be allocated space in the main area.

C. SYSTEM LAYOUT

The layout of equipment and accessories is governed by:

1. Power utility services
2. Lighting
3. Noise sources
4. Interrelationship of department process with preceding and succeeding processes
5. Fire and safety regulations
6. Air flow
7. Work flow
8. Floor loading capacity
9. Structural constraints: walls, columns, windows, etc.

Operational requirements and work flow patterns determine to a large extent the location of items. The dimensions, weights, service clearances, maximum cable lengths of each component unit have to be ascertained to determine whether the desired location is technically possible. The specification or site preparation sheet will give this information.

D. FLOOR CONSTRUCTION

Most U.S. buildings for office and plant use have a mininum rating. This will normally be adequate for most computers; if any doubt exists an evaluation should be made by a structural engineer.

The floor covering should be evaluated for:

1. Initial cost
2. Maintenance and cleaning cost
3. Durability
4. Generation of static electricity
5. Function
6. Appearance

The most critical point is often the maintenance and cleaning cost. This is labor intensive and over a period of time, cleaning costs can be considerable. The appearance is important so long as the selection has minimal cost and will contribute a positive result, however small.

In general, it can be said that tiled floors are advantageous because they:

1. Are scuff-resistant
2. Are resistant to many physical strikes by heavy or sharp instruments
3. Tend to resist staining
4. Can be purchased in a low-flammability composition

With every system, a considerable amount of interconnecting cable, mains supplies, and other service connections are required to the system and between the units of the system. In addition to being an eyesore, these are potentially hazardous to both personnel and equipment. Principal points to consider are:

1. Safety of personnel
2. Protection of power and interconnecting cable

Hiding or disguising of these cables can eliminate both of these concerns. The methods available include:

1. CABLE RAMP COVERS

This is a method of concealing and protecting cables routed over the normal floor covering. This method is relatively inexpensive, minimizes the hazard of cables, but can still constitute a hazard to personnel. In addition, the system does not offer the same degree of flexibility for change and expansion afforded by a raised floor.

2. RAISED FLOOR.

A raised floor is preferred because it offers the greatest safety to personnel and equipment, makes it easy to change or enlarge the systems layout, and provides the best appearance. The construction of the flooring should:

1. Be capable of withstanding the maximum weight requirement of personnel and equipment.
2. Provide convenient access to the services. Ideally the raised floor height should be 10 inches, certainly no less than 5 inches.
3. Properly ground all metal parts or fittings.
4. Allow inspection and connection apertures in the floor to be covered or concealed by the equipment.
5. Allow movement of units without incurring damage to the cable through obstructions in the aperture.
6. Have waterproof power connections.

E. SECURITY

The computer room requires special security precautions for these reasons:

1. A large quantity of high priced capital equipment is located in a very small area and is particularly vulnerable to fire damage.
2. The 'work' stored (e.g., magnetic tape, disk, etc.) took a considerable amount of time and money to initiate, sometimes representing years of work and experience.
3. During normal work periods, personnel are working with the system.

The following procedures should be followed should the system demand it.

1. Personnel should receive regular emergency drill.
2. A separate storage room or vault should be used to store duplicates of master

records or confidential records. The area should be fire-resistant and preferably located in a separate building.

3. All services should be inspected regularly and be routed away from equipment as far as possible. This includes power, water, steam, gas, etc.
4. The environmental conditions should be monitored and recorded 24 hours a day, 7 days a week to ensure that proper performance is maintained.
5. Storage in the working area should be kept to a minimum and contained in fire-proof cabinets where necessary.

F. ENVIRONMENT

To improve system reliability, control is required over the environment within which the equipment will be used. The components used in computer technology are necessarily subject to increased probability of failure if environmental conditions are not stabilized to meet certain minumum standards. Rapid change and excessive temperature, either high or low, adversely affect most computer systems. High humidity decreases the stability of porous materials and consequently decreases the usefulness of handling paper tape or cards, magnetic tape, and line printed paper. Low humidity increases the buildup of static electricity. Dust particles will increase errors and can prevent the proper use of magnetic tape, disk, or even paper tape. The presence of small quantities of foreign material will sometimes dramatically reduce the useful life of a device or storage medium. Electrical noise caused by environmental factors can cause hardware logic errors.

Finally, vibration can cause early component failure. Disk systems can be particularly susceptible to this problem.

The manufacturer's specifications for environmental conditions required for optimum life and usage should be maintained. Various units in a system often have very different ranges of tolerance. The Central Processing Unit is much more robust than a disk unit. In planning the site, see that the environmental requirements of equipment units are taken into consideration. The environmental control system must be able to cope with the most demanding unit of equipment. Finally, the most important factor in the department is the personnel. The recommended operating ranges are:

Temperature 70° ± 2°F (21°C ± 1°C)
Relative Humidity 45% ± 5% (no condensation)

1. AIR CONDITIONING

The air conditioning plant should provide cool, filtered, humidified air at a rate sufficient to keep the air pressure higher than in adjacent areas; this will prevent dust infiltration. To increase the efficiency of the plant, walls and ceiling should be insulated. Double glazing should be used on large window areas, and doors should be weather tight. Since most manufacturers install blowers in their equipment, only general room air conditioning is normally required. However, there are some devices which dissipate a great deal of heat. These devices create 'hot spots', which must be specially cooled.

To evaluate the cooling power required of the air conditioning system, the heat load created by all electronic units, personnel, and other factors should be calculated. The heat load calculations should take into account the following:

1. Equipment heat
2. Personnel heat
3. Utilities heat
4. Solar heat
5. Heat radiation from adjacent areas through walls, ceiling, and floor
6. Heat radiation from any other sources

The sum of the maximum heat generated from all sources constitutes the worst load condition that the air conditioning system will encounter. Air conditioning can be extremely expensive in terms of capital outlay and operating costs. To minimize costs, particular attention should be paid to air distribution and control.

Air entering or being recirculated through the system must be filtered. The filtration standard will depend on the units comprising the system and the number, size, and type of particles that are indigenous to the locale. Special filtration is only necessary when unusually dirty or dusty conditions are encountered or the source of input contains salt or is heavily corrosive. The filtration should have easily replaceable and washable filters.

2. ACOUSTIC DAMPING

Line printers, paper tape punches, card readers, teleprinters, magnetic tape transport systems, and other devices can and do create sufficient noise to affect the working environment. To minimize this distraction, the units should be soundproofed as much as possible and the surrounding area suitably treated. Floor materials and construction that reduce vibration should be used. The greatest sound reduction will normally be achieved by treatment of the ceiling, but the use of absorptive materials throughout the building will assist. Soft wall surfaces will prevent ringing and reduce vibrations.

3. LIGHTING

The normal light intensity required throughout the area is 40-50 foot-candles measured 30 inches above the floor (420 to 538 lumens per square meter at 76.2 cm above the floor). The light can be from natural or artificial sources. However, direct sunlight should be avoided because controlled light levels are required for reading illuminated panels. Direct sunlight can cause excessive heat and aging of delicate electronic indicators and parts. Where VDTs are located, care should be taken to ensure that light reflecting onto the VDT screen is minimized. The general lighting around the units may be reduced to improve the operator's ability to read the screen and to work comfortably with the units.

The site must be provided with emergency lighting to protect personnel and equipment against a sudden failure of lighting. Special attention needs to be given to areas containing equipment controls. Lights must not be powered from the computer power distribution panel.

4. STATIC ELECTRICITY

Static electricity is generated by the motion of two non-conductive surfaces in contact with one another. Chairs, furniture, people in contact with the floor covering, and people in contact with machines will generate static electricity.

The discharge of built-up static electricity can cause annoyance to personnel and, in many cases, affect the operation of equipment. To minimize this, the following steps can be taken:

1. Provide an anti-static floor covering. Floor covering, carpeting and carpet pads, are produced with anti-static properties. These properties may be included at the time of manufacture or they may be added later through treatment with anti-static agents. The treatment process often needs to be repeated.
2. Maintain the relative humidity levels over 40%.
3. Use grounded, raised metallic flooring, or flooring containing metal filaments.
4. Use furniture designed to minimize static buildup.

5. RADIATED EMISSIONS

FM or radar transmitters in close proximity to a computer system or its components can cause interference and affect the operation of the equipment. It should be noted that transporting magnetic storage (e.g., magnetic tape or disk) past such a source can cause interference with the recorded data. If problems are encountered, the magnetic tape manufacturer should be contacted for recommendations on how to cure the problems.

G. MAINTENANCE

Maintenance should be carried out strictly as suggested by the manufacturer.

H. ELECTRICAL SUPPLY

The manufacturer's specifications relating to environmental conditions and electrical supply must be adhered to closely. Normally, power voltage fluctuations should be less than ±10% from normal. A frequency deviation of less than ¼ cycle is usually acceptable.

Power fluctuations and interference can be caused by overloading of the transformers and feeders, and fluctuation of the supply. Other interference can be generated in-house by the starting up of major plant motors (e.g., printing press, air conditioning motors) or similiar switching of large loads of power.

Radio interference can be injected into the supply system through arc welding equipment, etc. Ideally, the computer's main power supply should be clean and should originate from the main switch board with no other equipment loads on the line. With severe interference, line filters and overvoltage protection circuits may be necessary. In any case, all non-computer equipment should be kept off the computer power lines. The system manufacturer should be consulted before and after the installation, and the electrical circuits should be checked before the equipment is installed.

CHAPTER TWELVE

DOCUMENTATION

The documentation supplied with the system or stand-alone VDT is very important. The main issue is whether the documentation contains the information needed to maintain and debug the system, not whether the documentation is elegant and sophisticated in form. Documentation represents a major portion of the cost of system development. Sketchy documentation usually indicates that the system is still evolving and may have serious bugs. On the other hand, excessive documentation generally indicates that the system is too old to be 'state of the art'.

A. FUNCTIONAL SPECIFICATIONS

These specifications basically tell the user what the system will do for him. These specifications should be clear, comprehensive, and easily understood by the user. The functional specifications usually form the descriptive basis for the legal procurement documents. The functional specifications should explain not how things are accomplished, but what the system will do. If an item is not in the functional specifications, it is probably not in the system. Do not take a saleman's word for items; make certain they are included. These specifications should be expressed in terms that can be understood by the concerned members of the printing and publishing staff.

B. THEORY OF OPERATION

This documentation describes how the considerations in the functional specification are accomplished. It should start out at a general level and end up at a detailed level. All other levels should be easily understandable from a conceptual level. An ideal approach is to begin with the copy flow and detail each terminal or computer process that affects the copy as it progresses. With a stand-alone VDT, the copy flow is easier to understand since it can be related directly to the keyboard, VDT screen appearance, and holes in paper tape.

C. PROGRAM DOCUMENTATION

Any electronic system — whether it be a stand-alone VDT, an OCR, or a real time computer-based system with many bells and whistles — should have good software documentation.

Scores of details must be considered and many decisions made during the development of an application for a data processing system. Most of this effort will be performed considerably in advance of actually putting the application into operation. All details concerning each and every application can hardly be remembered by one or even a number of individuals. Moreover, the loss of any individual who played a role in establishing an application can create a void in the total and accessible information needed to ensure accurate execution and control of the application. For these reasons, it is important to write down on paper all aspects of each application as quickly as possible.

A program package, containing all information pertinent to the particular program, should be prepared for each program.The exact form of the package is not as important as the inclusion of all necessary items. Among the many benefits to be derived from an adequately documented program package are that it:

1. Eliminates misunderstanding between data processing personnel and other personnel within an organizational structure, particularly after an application has reached the operational stage.
2. Aids programmers and other personnel concerned in understanding and maintaining an application after the program is in operation.
3. Provides a text on each application for indoctrination of new personnel and for enlightening other personnel as to the purpose and content of the application.

The program package should be prepared as the tasks of problem definition, problem specification, and programming are performed. The format for the package should be established as soon as possible after the study of a problem is undertaken. The following items should be included in the format:

1. Program name, number, and purpose.
2. Correspondence relating to decisions and agreements made. This includes matters, such as source data input availability, and output to be prepared and when it is to be rendered, approximate volumes of records and transactions, the method for handling various transactions and exceptions, and what codes will be used.
3. A narrative description of the run, including general and detailed block diagrams.
4. Various types of listings required for reference and cross reference, such as a listing of the program as written, program listing by instruction location, listing by operation code, etc.
5. A list of equipment required, both on-line and off-line, and the proper program addresses for on-line equipment.
6. The estimated running time for execution of the program.
7. Complete operating instructions. The following items should be included:
    a. Identification of the tape units on which the input files are to be mounted, and those to be used for record output.
    b. Specifications for proper console switch settings.
    c. List of all programmed halts and the prescribed action for each.

   d. Applicable restart procedures if other than a standard restart routine.
   e. Description of exceptions to normal routines, such as tape labeling, error correction, and so forth.
8. A description of all input material and equipment setups required.
9. List of items needed for output, such as tape reels, printed forms, and punched cards.
10. Instructions for labeling, storing, and distributing all input and output material upon completion of the run.
11. Detailed layouts of input and output records and printed forms.
12. Layout of main storage allocations showing assigned areas for input, output, subroutines, main program, constants and variables, and working spaces.
13. Layout of auxiliary storage allocation.
14. Description of register usages and contents as appropriate.
15. Designation, location, settings, and purpose of all switches used with the program.
16. A program history record containing items such as date program was written and assembled, programming progress, date placed in production, and description of any changes made.

Many in-house-generated systems are particularly weak in the documentation area. What if something should happen to the individual who has it all in his head? Only documentation could guarantee you the continuation of your program.

The following is a list of the types of software documentation that should be obtained with a system:

Program Listings
Source Tapes (paper and cassette)
Object Tapes (paper and cassette)
Elementary Flow Charts
Documented Code (all)
Software and Hardware Interaction
Diagnostic Software (fully documented)
Drawing List (complete)

A software release schedule reveals much about the program maturity and should be obtained with any purchased system. A study of the release schedule can reveal a great deal about program problems, general system difficulties, and status. It should contain the minimum information shown in the following example:

Program Name	**Release Date**	**Version**	**Size**
VDT Handler	Spring 76	8	4.2K Core

D. STATE DIAGRAMS AND EQUATIONS

These are the tools of the logic design which represent the thought processes that served as the foundation for a design. These state diagrams and equations are somewhat analogous to detailed artist's concept drawings as they apply to a building. Without these state diagrams it is very difficult for everyone to understand how the logic is supposed to work. These are the 'road maps' for the logic design. The equations are Boolean in form and may require advanced training for full comprehension.

1. LOGIC DIAGRAMS

These are the detailed engineering specifications and drawings for the logic design 'building'. This term is also used in programming to define the interaction of programs and the functioning of individual programs. All of the symbols on these diagrams should have labels indicating type. There should be no connections or symbols that are connected to nothing. The logic should be drawn with symbols in accordance with MIL-STD-806B entitled *Graphic Symbols for Logic Diagrams,* available through the U.S. Government Printing Office at nominal cost. It takes years of technical training to accomplish good logic design so do not be surprised if the details seem beyond understanding; these become more understandable if the road maps (state diagrams) and the language (MIL-STD-806B) are standard.

2. TIMING DIAGRAMS

These diagrams depict events that occur in relation to a master timing system. They are an absolute necessity in debug and maintenance since they're basically what an oscilloscope presents. All clock signals should be included on the timing diagrams. A statement from the manufacturer regarding the accuracy and completeness of these diagrams is probably the best insurance that one can obtain in this area. Perhaps that statement should be obtained regarding all major documentation items, particularly the software.

E. WIRING LISTS INTERBOARD/BOARD

These lists give the pin locations at which the back board wiring is connected. Lights and electrical panels can be seen through the front door of the normal computer; a multitude of wires can be seen through the back door. The wiring lists indicate the connections for these wires. Important signals should be named and their function described to facilitate maintenance and repair. Even if the vendor performs system maintenance, it cannot be done without proper documentation. The wiring list is consistently a weak-link in the documentation.

Often the component holding boards have wired interconnections. The interboard wiring lists for each different board should give the wire connection points, name the important signals, and give their functions.

F. CABLES AND HARNESS DIAGRAMS

In the operation of a system, the cables and harnesses often get broken by use. It is a good practice to have the connection diagrams so that a repair can be made; however, the system must be powered down appropriately or the 'repair' can cause costly damage. The manufacturer's description of the power down procedure for each cable repair procedure will be an asset.

G. POWER DISTRIBUTION DRAWINGS

These drawings indicate how the direct current, d.c., voltages are distributed for the operation of the logic, the indicators, etc. The d.c. power is generated from the building power by power supplies. These power supplies are often a weak link in a great number of systems.

H. MECHANICAL ASSEMBLY DRAWINGS

The drawings should be a grade above the sketch level to be adequate. Immature systems usually do not have adequate mechanical assembly drawings; making such drawings is often left until the system is settled down.

I. MECHANICAL PARTS LISTS

These lists should give the name, usage, and vendor of the mechanical parts that compose the system.

J. I/O DESCRIPTIONS

These are the hardware and software interfaces for the device's VDTs, line printers, phototypesetters, etc., that are connected to the main computer. In the case of stand-alone VDTs these are the interfaces for the paper tape reader, punches, and/or cassettes. I/O description is often an area that a manufacturer never gets around to accomplishing. In the event of a systems failure, the programmers always blame the hardware logic designers and the hardware designers always blame the programmers (software). Documentation can help eliminate this 'buck passing.'

K. PARTS LISTS

These lists should indicate the names of suppliers of all the components of a system. Do not be surprised if there are thousands of parts for even the simplest system. Apart from the completeness of this list, look for unusual suppliers that may be marginal. Have the manufacturer note the parts that require special selection because procurement of these parts may require long lead time. If the vendor is given the maintenance responsibility, it might be good procedure to insist that spares be on site for these special selection parts. Parts lists are particularly important in OCR-based operation, because, often in the recognition circuits, special components are used.

L. OPERATOR'S MANUALS

1. GENERAL

These very important documents must be capable of being understood by the lowest level operator. A hierarchy of manuals will usually exist for a complex system. It is important that each be clear to persons at the level for which it was written. The manuals should contain illustrations — the old adage that a picture is worth a thousand words usually holds true. The number of clear illustrations is generally more important than the level of sophistication of each one.

2. MARK UP

This manual is often given to a customer as a system description; it is an important document, but it is not a system description. It will indicate the typography commands that the system (or stand-alone VDT) is programmed for. More importantly, it will indicate the number of keystrokes required to perform a given typographical requirement. The number of keystrokes should be minimized since this type of keystroke takes far more time than a normal text type keystroke. The basis for a cost justification study comes from this type of document.

3. SETTING SAMPLES

It is very important to have the manufacturer specialize part of the mark up manual to your particular needs. Supply the manufacturer with work samples from several categories of your work spectrum and have him mark it up and produce the output product. You will then have a basis on which you can compare the cost savings on the proposed electronic system with the cost of your present methods. The comparison begins with a list of keystrokes required for both the old and the new systems. The three areas of concern are:

1. Input
2. Expected Editing
3. Typesetting Preparation

Now, preparation times can be determined for each. The remaining ingredient is makeup. Most electronic, systems require far less makeup than hot metal or other early systems.

CHAPTER THIRTEEN

VENDOR EVALUATION

A. INTRODUCTION

The technical aspects of a potential system are summarily evaluated by the composite of all the sections in this *Guide*. After it is determined that a particular system is technically capable of meeting your technical needs, the company that produces that system should be evaluated. This company evaluation is not a simple task. Common sense and a thorough technical evaluation of the vendor and his products will produce good insight. The following questions should be asked about the vendor.

1. Is there a large enough technically qualified staff to produce and maintain the system?
2. Is the technical staff experienced in the field of electronic composition?
3. What is the track record?
4. What is the cost-to-performance ratio of the system?
5. What resources will be used on your requirement?
6. What will the communication channels be as:
    a. specifications are written?
    b. the system is being produced?
    c. installation is being done?
    d. maintenance is needed?
7. Is the company profitable; can they afford (in the economic climate) the expense of getting to the profitable state?
8. What documentation will they provide with the system?
9. What is their maintenance policy with regard to:
    a. software?
    b. software revisions?
    c. hardware revisions?
10. Where in the product evolution cycle does the vendor stand — buying the first products produced in the cycle can be painful until all the bugs are corrected.

The answers to the preceding questions must be evaluated in light of the following information.

1. All systems will have some bugs.
2. The electronics business is full of hazards and the company with the best technical ideas may not have the management or financial means to be a continuing success. A system is a living entity and will need continual support and care; if the company is not alive the investment may suffer.
3. No matter how thoroughly the specifications are written, as the project unfolds there will be unresolved items which will need resolution and trade-offs will have to be made.
4. Implementation takes time.
    a. Approximately three months should be allowed for a stand-alone VDT from time of order to in-operation.
    b. Approximately one year should be allowed for complex real time systems from order to in-operation.
    c. For large systems that are one of a kind (i.e., the first few systems produced), a two-year period should be assumed between delivery and smooth uninterrupted work production.

B. SELECTING A SYSTEM VENDOR

Often a judgment or selection of a vendor is made on the basis of vendor size; this has a great deal of risk. If the system fails to live up to expectations, no one can blame a decision-maker who gave the job to a big, well-known and established company. But often the 'little' company, is far ahead of the big company in overall technical excellence of product and performance.

Do not get caught in the orange syndrome. If your wife, when grocery shopping, brings home a rotten orange from a small store you might say to her, "Don't buy there again." If your wife brings home a rotten orange from the larger supermarket you might say, "rotten orange," and simply throw it away. No matter what the size of the store, none of them has a corner on rotten oranges.

Don't let vendor size cloud your judgment — get what you want, need, and can use. This *Guide* will help you by calling to your attention all the considerations you should be aware of in deciding which system to buy. Buying a system will change the life style of a great part of your company; it will be a blessing or a curse, and will cost you considerably no matter which way it turns out. The vendor doesn't know what you need — only you can determine that.

C. IS SIZE IMPORTANT?

Size is not as important as it may seem, since in the final analysis, only certain people will be accomplishing the necessary work. If a company employs thousands of people you can be assured that they are not all just sitting around with nothing to do but get to work on your job. If they didn't already have a job to do they could hardly be carried on the payroll. If within the large numbers there is a smaller number of well-managed competent people, a large company offers some advantages. Since RCA cut its computer efforts, people's faith in large companies has undergone a change. Large companies can dispose of divisions which may make sense for the well being of the whole but this means hardship for the division's customers. In these days of 'tight' money, the larger companies should have generally better staying power and the ability to survive economic dislocations. The important items still center themselves around a few basic concerns:

a. Are there people who are competent and can do the work efficiently?
b. Are these people experienced in the trade?
c. Do these people work well together as as team?
d. Are the technical people well-managed?
e. Do good communications exist within the group and company?
f. Do the people identify with the product, or is it just a job?

In the final analysis, technical people are important since the product you want is complex and not entirely on the shelf. You will have to depend upon the company's technical personnel to generate and maintain your system. One way to judge a vendor is by the ease and honesty with which your questions are answered. This is usually true unless the company has a specialized group who just write proposals and then turn them over to others to have them executed. If the vendor has a specialized group for answering your questions you should be cautious. Sometimes a company will use its best people to make the proposal and sales presentation but rely on others to perform the work. Small companies cannot afford this luxury. A search of employee turnover will give a good indication of the stability of the technical group. Stability is very important since even the brightest people need long orientation and training before they can contribute materially to the work effort.

The most important thing you ought to do is to specify everything in detail so that you know what you are getting, particularly from an operational point of view. Don't leave this to the vendor — you cannot expect him to be clairvoyant about your needs. If you just buy what the vendor ships it will probably not satisfy your detailed needs nor give you a competitive advantage for your position in the market.

The following table shows some of the important items in vendor selection when considering large and small companies.

Table Fifteen. Vendor Selection Considerations

Considerations	**Large Company**	**Small Company**
Importance of Your Order	Just one of many	Very important for company's future
Competence	In final analysis boils down to few select people	Select people who can more easily identify with company's future
Reaction Time	Generally long — many people in decision loop	Generally short if directed to proper individuals
Selling Emphasis	Generally well-planned V.I.P. treatment	Generally a spur-of-the-moment best-efforts basis on part of all

Table Fifteen. (Continued)

Descriptive Literature	High quality print, usually covers a wide range of inputs from a large number of individuals	Generally informative result of few individual efforts
Maintenance Staff	In spite of large number of people, only those trained and competent are to be considered	Usually small, highly-mobile group
Ability to Respond to Specific, Necessary Changes	Approval cycle sometimes long	Few individuals sometimes used on many jobs

CHAPTER FOURTEEN

MAINTENANCE

A. GENERAL

The maintenance of any electronic system is much more complicated than the maintenance of some of the almost indestructible mechanical equipment that the industry has dealt with in the past. Maintenance is defined in this section to mean any activity intended to keep equipment, including programs, in satisfactory working condition. Maintenance includes tests, measurements, replacements, adjustments, and repairs. When a piece of mechanical equipment breaks down, there is usually a good visual reason for the problem — a broken linkage or a stripped gear. When a piece of electronic equipment breaks down, visual inspection may not yield any clue to the problem. After all, electrons are difficult to see even for the computer scientist.

The proper atmosphere will improve the performance of any computer system. Good temperature control and a clean environment will pay good dividends with computer systems and electronic gear. The human interfaces, such as keyboards, switch panels, etc., have usually been designed to provide reliable service; however, they will not take a lot of abuse.

In the past, there have been basically two distinct methods of accomplishing maintenance. One is to train in-house personnel and the other is to contract with the vendor. A third method, the combining of the other two methods, may have a great deal of merit. Let the vendor train your in-house personnel to their upper level of capability and, in addition, contract with the vendor for maintenance.

B. IN-HOUSE

In general, the concept of having in-house personnel capable of maintaining a complex electronic system should be carefully considered. With stand-alone VDTs, in-house maintenance is usually quite feasible, especially if the production deadline can be met utilizing alternate (without the VDT) methods. A well-designed VDT can usually be repaired by electronic circuit board replacement. Often, a telephone call to the supplier can result in a 'walk through' procedure that will probably correct the problem if appropriate spare boards are on hand.

Solutions to problems in complex systems do not usually come that easily. The basic concern with complex systems is that they consist of two main ingredients: hardware and software. Traditionally, it is difficult to find electronics personnel skilled in both areas (unless the individual is unusually gifted). In the event of system failure, the failure may be caused not simply by one problem, but by a composite of several things. If separate people handle the software and the hardware, sometimes it takes a while for each to convince the other where the problem is.

An unusually gifted person will not usually be content with maintaining a given system over an extended period of time — unless the system is continually expanding. The multi-area, skilled individual more naturally gravitates to the system design area. Normally these individuals exist within the array of personnel that the vending company possesses and can be used in 'fall back' mode if the vendor is responsible for maintenance. Before hiring such people, the printer and publisher should consider a number of things. These people are rare within the trade, they usually command a high price, and like to involve themselves with design aspects. Hiring this type of individual and allowing him to do in-house design work does not usually produce the desired results because of lack of proper support. Design efforts require a team of people with varying talents; what firm desires to hire a whole computer team with its attendant management problems?

In-house maintenance, by itself, is usually an inefficient, high-cost approach. However, if it is combined with vendor maintenance, it can produce excellent results.

C. VENDOR

Contracting with the vendor to perform maintenance requires several very important considerations. The skill level of the people who will be used in the event of failure is very important. No matter how big the organization, the actual performance of the job will become the responsibility of a few individuals. Will those individuals be qualified? Having a lot of people to run around is not the criterion of quality. If the customer's system involves a great deal of special equipment and programs, the problem becomes even more difficult. A good staff, knowledgeable in 'standard' equipment, may exist, but what about the special equipment that is usually part of most systems?

The task of measuring and determining the competence of the vendor's maintenance team is difficult. Nevertheless, a great deal of insight can be obtained. One of the first items to determine is the maintenance team's training on your type of equipment. If the other responsibilities of the maintenance team are not on your type (class) of equipment, it is usually an undesirable situation. It is also a good idea to have a 'road map' leading upward in skill level right to the design team that designed your system. This road map will be of great assistance when the problems are difficult to track down. Fortunately, for tight deadline situations, catastrophic failures are generally easier to locate and fix than intermittent — now it works, now it doesn't — situations.

Backup of equipment is a very important consideration. Some feel that if they have two complete systems they are fully backed-up. This is often a fallacious assumption — whatever caused the problem on one system could cause it on the other. It makes far more sense to purchase selected backup capabilities for one system rather than to have duplicate systems. A detailed failure analysis of the components that make up the system, such as is done for military projects, will usually point out the areas where the backup is needed. The space project that put man on the moon did not use duplicate propulsion systems and yet the project was backed-up in many ways.

Telecommunications opens up a whole new area of system backup. If several equipment installations exist which can perform the necessary work, a telecommunication link-up with these other installations might be established. This approach favors a distributed processor system in lieu of one major large computer.

Studies involving failure analysis are complex and management may well turn to outside help for determining the most efficient (cost and performance) methods for backup. The reliability of a similar system in some other environment, although usually a good indicator, may not be that which will be experienced. This is particularly true in complex systems when they are more fully utilized and the system utilization intelligence is increased. The higher degree of utilization a system is put to, the more likely it is to fail. A system may never fail if it is lightly loaded doing simple tasks, but may well fail because of software bugs when it is heavily loaded doing complex functions.

Having a duplicate system may provide you with a feeling that is analogous to the feeling that you can always go if you have two cars in the garage. A temperature dip in the night may have knocked out both batteries so that you cannot go with either car. An additional backup battery up on trickle charge would have been more effective than the duplicate backup. Everyone who has two cars knows that both are not usually unable to perform at the same time.

Overvoltage conditions, sometimes caused by lightning striking building power sources, will effectively wipe out two systems as easily as one — if they are connected.

Duplication of equipment is a form of backup, although usually the most expensive method. Suffice it to say that with little imagination it can easily be seen that mere system duplication does not necessarily provide the same insurance of being able to operate as does well thought out backup. Backup is always less expensive than 'duplicate' systems. Backup procedures will enable you to afford a greater spectrum of protection. Duplication, since it is high-cost, will limit your protection spectrum. The greatest spectrum of protection may be the most valuable since system failures occur for a variety of reasons. Backup may require the operating procedures to change in the event of failure. This change may be costly. The cost should be traded off against that required for duplications. Newspapers with tight deadlines may be forced to use both systems, duplication and back-up, to insure meeting the deadline.

Vendor maintenance begins with a well-written contract that includes, as a minimum:

1. Personnel who will perform maintenance.
2. Reaction time specified in maximum hours that will transpire after a call is placed and the maintenance people arrive on site.
3. A delineation of the spares
   a. on site.
   b. in vendor's local office.
4. Guarantees of ability to get system on the air within a certain length of time after

notification.

5. Guarantees of minimum time to first failure and minimum time between failures. (Perhaps this should be, more properly, in the procurement contract document).
6. A delineation of preventive maintenance.
    1. Proper cleaning of air filters.
    2. Running of diagnostic maintenance software routines.
    3. Focus, intensity, and stigmatism on VDT.
    4. Measurement of d.c. power supply voltages.
    5. Routine maintenance of storage devices including a provision to demagnetize and align heads.
    6. Other items suggested by vendor.
    7. List of test equipment requirements.
    8. Documentation to be kept on site and maintained (updated, etc.)
    9. Priority of your project.

D. COMBINATION

The most effective means indicated by past experience, is to train in-house personnel to their maximum capability and have the vendor's personnel available on call. Even if the in-house personnel can only maintain the system documentation, it would be worthwhile.

One risk that is taken with this approach is that the vendor's personnel can blame the in-house personnel for causing failures through improper action. This can usually be circumvented by paying the vendor only for services rendered rather than for being available; the vendor may try to give you a lower priority for services on call rather than on a flat monthly fee — you can settle this before you purchase the equipment.

If in-house personnel have maintenance responsibilities, they usually see to it that the equipment is not abused; this is valuable within itself.

CHAPTER FIFTEEN

DIAGNOSTIC SOFTWARE

Since diagnostic software is so important, it will be treated as a separate chapter in this new *Guide* to electronic composition.

Diagnostic software are programs that are written to test the system in the event of a malfunction. These programs are often called debugging routines. These program routines are important even in a stand-alone VDT. No system, particularly in the shakedown phase which occurs just after installation, operates perfectly. Well-written diagnostic routines can help to locate and correct failures. If the diagnostic routines cannot pinpoint the failure they should be able to isolate the problem to particular system components or interfaces.

A VDT, in a sense, has a built-in diagnostic for a portion of its logic; when an 'A' is depressed on the keyboard, an 'A' should appear on the screen — admittedly, the operator performs part of the loop.

A diagnostic program should exercise parts of the system by giving it tasks to perform and should check the results of the performance of the task. Writing diagnostic programs can be an almost endless task on a large system. The diagnostic programs could check for proper operation right down to the component level. A judicious compromise must be reached between what is nice to have and what is necessary. As a minimum, all the major parts of the system, as specified in the theory of operation manuals, should be tested by diagnostic programs. One usually troublesome area is the available space file on a large multi-disk system. A diagnostic should be available that will check the available space-handling programs to see if they function properly. Do not confuse operating software such as loaders and utility programs, with the fault-finding software, the diagnostic routines.

On a stand alone VDT, the diagnostic routines would probably consist of test tapes which would be read into the terminal, punched out, and re-read in.

On large systems a great deal more is required. In general, the computer manufacturer will supply the system vendor with diagnostic routines for testing the computer. The data base should also have comprehensive diagnostic routines. All I/O, such as VDTs, line printers, typesetters, and telecommunications should be able to be tested for proper functioning by comprehensive diagnostic routines. Ideally, these diagnostic program routines should be stored on disk, called into the systems as required, and should run concurrently with work being accomplished. This is asking a lot from the system and obviously is not possible with regard to the computer CPU.

A. STORAGE

1. TEXT

Diagnostic software must exist for the storage medium used on any large computer-based system. The software should determine if the text can be stored on the medium and retrieved without error. Since this storage test is input-output (I/O) independent, it should be able to be enacted on any I/O device existent within the system. The ideal diagnostic test should be to store and retrieve text of maximum take length or some other convenient large block size. All the text and typographic commands used in the system should be used in the storage and retrieval test to determine if bits are lost or changed.

2. PROGRAM

Since system programs are stored on the system media, diagnostic programs should exist to determine if these programs are stored properly. Stored programs must be protected within the systems to prevent unauthorized changes. This protective mechanism must be tested as well.

3. DIRECTORY

A diagnostic routine to test the directory establishing and maintaining software is highly desirable. Available space should be tested to determine if fragmented files are allowed to clutter up space that could normally be used for text file storage. Since the directories are different segments of the rotating magnetic storage, a test of all text storage tracks and sectors is not sufficient.

4. QUEUING

These programs which automatically route the copy within the system are very important to test. A routine should be devised to automatically route a text file through all the queues in the system. Queue entry and exit procedures should also be tested.

B. INPUT

These test routines should test all of the input handling programs for all the functions they perform such as:

1. Formatting of data
2. Temporary storage
3. Code conversion
4. Data manipulation.

C. EDIT

These routines should test all of the edit functions that:

1. Are local to VDT and OCR, etc.
2. Involve file manipulation
3. Involve processing by typography programs.

D. PROCESS-TEXT

These routines should check the proper function of the typography programs on standard test files of text to determine proper functioning of the justification and hyphenation, and typography routines.

E. TYPESETTER

This test routine could consist of a test file of text which exercises all of the features of the typesetter. The set sample could then be compared to a good previously-set version of the same file.

F. I/O (INPUT/OUTPUT) DEVICE TESTS

These routines should test, utilizing test files, the proper functioning of all I/O devices such as VDT, OCR line printers, paper tape equipment, etc.

CHAPTER SIXTEEN

FUTURE INDUSTRY DIRECTIONS

A. INTRODUCTION

As the integrated circuitry art improves, more and more electronic capabilities will be available to the printing and publishing industry at lower and lower costs. No one should be dissuaded from buying a system now if it will fulfill meaningful requirements and is cost-justifiable. Larger, better and lower cost integrated circuits will result in lower and lower costs for minicomputers. With lower minicomputer costs made possible by the monolithic processor revolution, more distributed systems will come into being with a multiplicity of computers working in harmony rather than everything being done on one large central computer. Two things will then occur:

1. Minicomputer prices will continue to drop. A PDP-11 class computer (the type used by several manufacturers of systems for printing and publishing) will probably cost only a few hundred dollars by 1980.
2. Computer programming costs will continue to rise, making it desirable to write the programs in simple modules.

The distributed computer (processor) approach will mean that a small (printer) operator can get into an electronic system by starting with a building block such as a stand-alone VDT, then adding to it. There are no manufacturers, at present, whose equipment will properly allow this approach. The most logical approach to a building block system would be to start with a stand-alone intelligent VDT. None of the stand-alone VDTs available today ideally meet this requirement. VDTs are the best tools available for editing; if their price tag were low enough, they could easily become the best input devices. Other input devices such as keyboard, OCR, and typewriters have almost bottomed out in their descending price curves. VDTs have not yet reached this bottoming out level and future VDTs will have considerably reduced price tags. With the integrated circuit manufacturers reaching out for places to go (aside from the overcrowded desk calculator market) they will probably push into the EDP (electronic data processing) video display terminals. Admittedly, these EDP-VDTs are grossly different from the ones required by the printing and publishing industry; a lot of terminal companies producing EDP-VDTs will find themselves trying to survive by turning to producing VDTs for the printing and publishing industry. Keep in mind that a good VDT for EDP can be purchased for less than $1,000.00 at the present time. This price is considerably lower than the present $7,000-plus for a printing and publishing stand-alone VDT.

With a distributed computer system one computer will probably be used to handle input, another to handle the bulk secondary storage (data base management), and another to perform typography calculations and set the type. This breakdown may even reach a lower level. The thrust will always be to reduce program costs by breaking them up into modules; modules which run on individual minicomputers. Another aspect of the thrust will be to write the programs in compiler level language (compilers are simpler for more programmers to write) rather than assembler level languages (assemblers), as is presently done. Compilers require more memory space than assemblers, but the cost of the additional memory space for the compiler to function is, even at this point, almost negligible. Compilers require more time to run than do assemblers, but the additional program run time for compilers (execute time) will become negligible in distributed systems and will not seriously degrade their performance.

Another phenomenon will occur just as it did in the phototypesetter area. Certain hardware and software modules will become so low in cost that users will adapt to them rather than insist that the system be tailored to their individual requirements. This adaptation to standard modules will be more easily accomplished in the smaller shop environment rather than in the large printing and publishing institutions.

B. NEED FOR STANDARDIZATION

In order to allow the surging state of the electronics art to have its fullest financial impact, one of the most obvious needs in the industry is standardization. The following standardizations are sorely needed:

1. A standard 8-level transmission code
   a. for newswires
   b. for data transmission
2. Standard Directory methods for newswire information
   a. content addressable
   b. content related numbering schemes
3. A standard code for driving typesetters
4. A standard unit of measure for typesetters
5. Program standards for typography programs
6. Standard mark-up languages
7. OCR input standards for font and codes
8. A standard glossary of terms
9. Standard systems performance specifications

The electronics industry, by itself, will not establish these standards. The initiative must come from within the printing and publishing industry.

The economic savings to the printing and publishing industry brought by the adoption of standards would be huge and have far-reaching effects.

C. FUTURE THRUSTS IN EQUIPMENT

In the copy preparation cycle, several significant equipment development thrusts will emerge. The most talked about, at present, is the so-called full-page thrust. Another thrust, perhaps even more significant, is the creation of a building block approach to the total system. This thrust has not yet begun since no manufacturer has a good stand-alone VDT that is also the best for use in a large computer-based system.

Several significant development thrusts in the area of auxiliary (not related to the copy preparation cycle) tasks for the computer system are already developing. These are in the areas of business data processing. In the study on classified ads, Chapter 8, it was very apparent that the savings, as a result of an electronic system, were almost as significant in the overhead costs as they were in the direct copy preparation.

Systems will become more capable of saving costs in the overhead areas. Management information, supervisory control, and accounting procedures will all receive greater 'help' as the technological thrust continues. These 'helps' will, in themselves, be very worthwhile.

Turning our attention strictly to the pre-press copy preparation work, we see that several significant features will be added to future systems. If we consider the total copy preparation, consisting of two general categories — input (getting the data into machine form) and edit (making all the changes necessary to produce the desired copy) — we can ascertain what the technological thrusts will bring.

1. INPUT

	Present	**Future**	**Ultimate**
Systems	Typewriter & OCR	Present + handprinting and OCR	Future + handprinting and OCR
	Direct typewriter	Low cost VDT	Voice to computer
Stand-alone V.D.T.		Intelligent VDT	Super-intelligent VDT

2. EDIT

Editing has been broken down into:

a. location of position for change/edit.
b. performing the change which may consist of:
    1. text edit
    2. edit of typography
    3. edit of artwork
    4. any other type of edit.
c. Restoration of the material to desired form — appropriate blending of the change with old material.
d. Checking to determine if process was correctly done.

3. PRESENT, FUTURE AND ULTIMATE FEATURES CHART

The following is a chart depicting present, future, and ultimate systems capabilities and features:

FEATURE	**HARDWARE**	**PRESENT**	**FUTURE**	**ULTIMATE**
GENERAL EDITING PROCEDURE	OCR typewriter	Deletion symbols for OCR; typewritten corrections	OCR will read some controlled handprint	OCR will read handwritten material
	On-line VDT	Index search; scroll text; move cursor	Index search; scroll text; move cursor automatically	Automatic placement of cursor
	Stand-alone VDT	Locate input tape; make new output tape	Make new output tape from old output tape	Automatic production of new output tape
LOCATING THE POSITION TO MAKE EDIT CHANGE	OCR typewriter	Locate sheet of paper	Use VDT (to call out from computer memory)	Use VDT (for automatic call-out)
	On-line VDT	Index in machine form	Index by contents	Index by automatic, associative search; cursor moved automatically
	Stand-alone VDT	Manual text scroll; cursor moved manually	Manual text scroll; cursor moved automatically	Automatic scroll; cursor moved automatically
MAKING EDIT CHANGES				
TEXT AND TYPOGRAPHY	OCR typewriter	Leave space; move space: retype text or instructions	Use VDT	Use VDT
	On-line VDT	Insert, delete, move text block or character	(Text): insert delete, move block or character (Typography): make any change, see screen representation	(Text): insert, delete, move block or character;) enter change, instructing computer to locate and make change (Typography): CRT screen facsimile of typesetter output; make any change, screen relects change
ART AND GRAPHICS	OCR typewriter	Leave space	Use VDT	Use VDT

	On-line VDT; stand-alone VDT	Leave space; move space; no representation of art	See art representation; move representation; full color displayed in three separate black images	See actual art; move, size, crop at will, view full color displays
RESTORATION OF COPY AFTER EDIT				
TEXT	OCR typewriter	Retype copy	Use VDT	Use VDT
	VDTs	Paragraph restoration	Page restoration	Final product restoration
ART	OCR typewriter	None	Use VDT	Use VDT
	VDTs	No restoration	Automove	Automove and size
VERIFICATION OF EDIT AND RESTORATION	OCR typewriter	None	Use VDT	Use VDT
	VDTs	By operator	Computer-assisted manual means	Automatic
TYPESETTING	All typesetters	Black and white output to plate through negative intermediate; film output to plate	Black and white input directly to plate	Color and three-dimensional input directly to press and substrate

Future developments and trends will be aimed at the reduction of non-creative, time-consuming, labor-intensive operations. The goal is not to eliminate human intervention, but to reduce drudgery and allow more time and scope for human creativity. The ultimate process should allow complete freedom for the translation of human thoughts to printed form with the minimum of effort, cost, distortion, and loss. Eventually, even 3-D books may be produced with holographic techniques.

D. THE INDUSTRY AND THE FUTURE OF LARGE SCALE INTEGRATION (LSI)

Thrusts in large scale integrated circuit and computer technology will affect the future capabilities of electronic systems used for typesetting. There are currently over 50 manufacturers producing over 160 different models of minicomputers. There are over 160 different models of CRT (VDT) terminals being made by over 60 suppliers and over 8,000 terminals installed for electronic data processing (EDP) applications. It is projected that by 1977 there will be over one million general-purpose and dedicated application terminals installed for EDP. As this industry thrusts forward there will be technological spill-over into electronic systems for typesetting.

Present-day microprocessors (monolithic processors) will continue to grow in capabilities and they will 'swallow up' the minicomputer in capabilities within the next 5 years. Every semiconductor manufacturer and every computer firm with vision is involved in the development of monolithic processors. The present microprocessor circuits are comparable to the auto industry's 'model T.' A 300-dollar minicomputer will appear; software will be by far the largest cost in an electronic typesetting system. The lower computer prices will result in distributed systems with functional modules that will reduce the software costs. If standards can be established for these modules, the printing and publishing industry will reap great economic benefits.

Microprocessors, as they now stand, are built with MOS (Metal Oxide Semiconductor) processes which produce slow devices compared to other integrated circuit techniques. Because of the limited size of the microprocessor's memory (usually read only) and control circuits, the instruction set for microprocessors is much smaller than that for minicomputers. In addition, present microprocessors have very limited output drive capabilities. The few VDTs built to date with integral microprocessors are slow in response even to the requirements for editing text, and are completely lacking in the speed to perform typographical functions such as justification and hyphenation. This speed situation will change in the very near future when it will be possible to have the central processing unit, a universal interface adapter, direct memory access, bus control, clocks, and timing circuits on a single LSI chip.

It will soon be possible to build the capabilities which formerly were available in 'large' tape-driven typesetting computer systems into a single OCR or VDT.

The reliability of these new microprocessors will be far greater than anything yet experienced, making concepts of duplication for backup obsolete. Just as it is now possible to replace circuits on a printed circuit board by plugging in new ones, in the future it will be possible to plug in a new computer.

Electromechanical input-output devices such as typesetters, line printers, and magnetic tape will not directly benefit from the new LSI (large scale integrated) circuit thrusts and will continue to be high-cost, less reliable components of the electronic typesetting system.

LSI will give way to VLSI (Very Large Scale Integration). Computer processes, which in the past were very expensive, will be within the reach of even very small shops.

CHAPTER SEVENTEEN

EQUIPMENT FEATURES CHECK LISTS

The purpose of this section is to provide check lists for easy reference when evaluating, comparing, or otherwise considering keyboards, typewriters, OCR systems, stand alone VDTs, electronic systems, and typesetters. The list is not intended to be all inclusive, but only to point out the major items of concern.

A. OCR AND TYPEWRITER:

- Input
  - Maximum Document Size
  - Minimum Document Size
  - Continuous Form
  - Margins-Dimensions-Tolerance
  - Effective Reading Area
  - Maximum Characters in a Line
  - Minimum Characters in a Line
  - Number of Lines per Inch (5 or less)
  - Skew Tolerance
  - Paper Weight Range
  - Paper Quality Range
  - Paper Color Range
- Recognition
  - Fonts
  - Character Set
  - Hand Print
  - Multifont by Zone
  - Multifont
  - Mark Sense
  - Form Handling
- Feed Mechanism
  - Maximum Hopper Loading
  - Minimum Hopper Loading
- Transport Mechanism
- Scanning Technique
- Scanning Speed
- Recognition Technique
- Recognition Speed
- Error Handling
  - Automatic Rescan
  - On-Line Operator Correction
  - Serial Check
- Document Delivery
  - Order
  - Sorting
- Electronic Output
  - Paper Tape
  - Magnetic Tape
  - Disk
  - On-Line
- Logic Controller
  - Handwired
  - Computer

- Peripherals Available
  - VDT
  - Interim Storage
  - Teletype
- Performance
  - Documents Per Minute
  - Line Per Minute
  - Characters Per Second
- Editing on Typewriter
  - Delete Character
  - Delete Word
  - Delete Line
  - Delete Block
  - Insert Character
  - Insert Word
  - Insert Line
  - Insert Block
  - Move Word
  - Move Line
  - Move Block
- Output Format
  - Coding Structure
  - Macro Codes (character explosion)
  - Character Implosion
- Software/Hardware Division
  - Monitor (control)
  - Recognition
  - Editing
  - Sorting
  - Merging
  - Updating
  - Justifying
  - Hyphenating
  - Code Conversion
  - Storing
  - Filing
  - Directories
  - Data Base
- Forms Design
  - Available from Manufacturer
  - Standard Forms
  - Manufacturers' Design Assistance Available
- Forms Printing Requirements
  - Ink Color (s)
  - Printing Process

B. VDT STAND-ALONE

This list is a compilation of most of the important features in a stand-alone VDT.

- keyboard
  - Number of Alphanumeric Keys
  - Number of Special Sign Keys
  - Number of Control Function Keys
  - Number of Cursor Movement Keys
  - Repeat Key
  - Number Typography Keys
  - Number of Multicode Keys
  - Entry Speed
  - Roll Over Feature
  - Double Strike Protection
  - Depression Force/Travel
  - Keytop Shape
  - Keytop Legends
  - Number of Display State Lights
  - Number of I/0 State Lights
  - Number of Customer-Arrangeable Keys (locations and codes)
- Type of Interlock
- Display
  - Screen Size
  - Number of Characters in Line
  - Number of Lines
  - Legibility and Stability of Display Signs
  - Sign (character) Repertoire
  - Different Font Styles
  - Format Handling Features
  - Sign (character) Matrix Size
  - Vectors, etc.

  - Variable Margins Minimum
  - Variable Margins Maximum
- Cursor Positioning
  - Right, Left, Up, Down
  - End of Line
  - End of Text on Screen
  - End of Text off Screen
  - Beginning of Text off Screen
  - End of Memory
  - Beginning of Memory
  - To Grid Location
  - To Text Location
  - To Sign Location
  - Next Paragraph
  - Set Tab Position
  - Set Tab Text
  - Tab Forward
  - Tab Back
  - Roll Up
  - Roll Down
  - Mark
  - Return to Mark
- Edit Character
  - Insert
  - Delete (delete implies close up of text)
  - Overstrike
- Edit Word
  - Delete
  - Store
  - Move
- Edit Sentence
  - Delete
  - Store
  - Move
- Edit Paragraph
  - Delete
  - Move
  - Store
- Edit Block
  - Delete
  - Move
  - Store
- Edit Line
  - Remove (no close up)
  - Delete (close up)
  - Open
  - Store
- Edit String
  - Remove
  - Delete
  - Replace
  - Store
- Tape Handling
  - Reader Speed
  - Reader Manufacturer
  - Reader Model Number
  - Punch Speed
  - Punch Manufacturer
  - Punch Model Number
- Tape Format
  - Code
  - Sprocket Feed (center/advance)
  - Level
  - Multiple Readers for Input
  - Tape Merge Input Tapes
  - Reprocessability of Output Tape (read in and edit typesetter output tape)
  - Merge Output Tapes
  - Merge Tape and Keyboard
  - Insert Tape at Cursor Location
- Memory
  - Type (core, solid state, volatile, nonvolatile, etc.)
  - Size, Main
  - Size, Auxiliary
  - Output from Cursor
  - Input to Cursor
  - Main to Auxiliary
  - Contents Retained in Restart
  - Auxiliary to Main
  - Efficient
- Format Storage
  - Format Number on Screen (for fill in)
  - Size
  - Output (save/destroy)
- Selective Output (to paper tape or memory, etc.)
  - From Cursor

  - To Cursor
- Bits per Character (internal storage)
- Internal Code
- Output Code Options
  - 6-level TTS
  - 8-level ASCII
  - Other
- Editing Delimiters
  - Definitions
  - Customer Specified
  - Fixed
- Typography
  - Automatic Justification (on the fly)
  - Delayed Justification
  - Can Cursor Be Backed up Without Necessity to Reprocess Take
- Auto Hyphenation
  - Delayed Hyphenation
  - Cursor Back-Up without Necessity to Reprocess Take
- Internal CPU
  - Programmable — Software/Hardware
  - Mini/Basic Family
  - Micro/Type
- Other
  - Strip Newswire
  - List of Typesetters for Which Programs Exist

C. KEYBOARD

- Keyboard Layout
  - Number of Alphanumeric Keys
  - Number of Keyboard Control Keys
  - Number of Function Keys
  - Number of Special Sign Keys
  - Secretary Shift
  - Backspace
  - Delete/Erase/Rubout
  - Repeat Key
  - Roll over
  - Double Strike Protection
  - Depression Force/Travel
  - Keyspacing Angle
  - Keytops Legend
  - Key Top Shape
  - Adjustable Touch
  - Multicodes
  - Programmable Keys
  - Type of Interlock
  - Run out Blank Tape
  - Coding Structure
  - Reset
- Memory Buffer
- Keyswitch Mechanism
- Keyboard Circuitry Components
- Indicators
  - Number
  - Shift/Unshift
  - Upper/Lower Rail
  - Super/Unsuper Shift
  - Upper/Lower Magazine
  - Typeface
  - Typestyle
  - Typesize
  - Font
  - Justification Zone
  - Count Down Indicator
  - Last Code Display
  - Last Character Display
  - Character Set for Display
- Reset Line Values on Delete
- Justification
  - Measure Length Units
  - Maximum Measure Length
  - Width Counting Units
- Width Storage
  - Maximum Number of Characters
  - Maximum Number of Styles
  - Card-Plug-Read Only Memory (ROM)
- Minimum Unit Value
- Maximum Unit Value
- Overset Entry Lock

- Audible Warning (justification zone and overset)
- Papertape Handling
  - Reader Speed
  - Punch Speed
  - 5-6-7-8 Level Tape
  - Center/Advance Sprocket Hole
  - Multiple Input/Output
  - Tape Merge
  - Tape Width
- Other Input
  - Magnetic Cassette
  - Magnetic Tape
  - Magnetic Disk (flexible disk)
- Other Output
  - Magnetic Cassette
  - Magnetic Tape
  - Magnetic Disk (flexible disk)

D. SYSTEM

This section lists most of the items of concern in a computer-based electronic system. The list does not include every item of interest; however, it does include the major concerns.

With regard to the input devices see the following sections:

OCR Input: Section 17-A
VDT Input: Section 17-B
Typewriter and Keyboard: Section 17-C

1. CHECK LIST FOR ELECTRONIC TYPESETTER SYSTEMS

- Central Processors
  - Model Numbers
  - Manufacturers
  - Data Word Size
  - Processor Speed
  - Memory Speed
  - Memory Size
  - Memory Options
  - Address Capacity
  - Addressing Method
  - Interrupt Handling
  - Power Fail-Restart
  - Instruction Set
- Processor Occupancy
  - When System is Fully Loaded
  - Average Loading
- Storage Type
  - Magnetic
  - Paper Based
  - Data Rates
  - Latency
  - Capacity
  - Redundancy
- Typesetting
  - Mark-up Language
  - Features
  - Defaults
  - Width Tables
  - End of Take
  - Translation Tables
  - Justification
  - Hyphenation
  - Formats Length
  - Format Stringing (Chaining)
  - Formats Nesting
  - Typography Functions Implemented
- Line Printer
  - Speed
  - Format
  - Code Translation Table
- Other I/O
  - Software Speed

  - Hardware Speed
- Software
  - Reentrant
  - Modular
  - Documenation
  - Code
  - Source Data Listings
  - Object Data Listings
  - List of Subroutines
  - Flow Charts
  - Diagnostic Routines
    - Storage
    - Input
    - Edit
    - Process Test
    - Typesetter
    - I/O tests
- Power Fail — Restart
- Maintenance
- Operator Internal-Technical
  - Manufacturers
- Updates
- Hardware-Software Interaction
  - Definitions
- Enhancement Software Policy
- File System Implementation
- Directories
  - Implementation
  - Entry Size
  - No Entries
- Queuing
  - Time
  - Automatic
  - Hierarchical
- Statistics
  - Operator
  - Department
  - Job Cost
  - Historical
- Coding
  - TTS
  - ASCII
  - Other Levels
- File Access Commands
  - Others Basic
- Newswire
  - Directory
  - Editing
  - Purging
  - Wire Stripping
  - Advance Copy Handling
- Classified Ads
  - Form
  - Error Checking
  - Credit Checking
  - Text Input
  - Classification Methods/Sorting
  - Modification Procedures
- Classified Statistics
  - Column Inches Total
  - Column Inches Classification
  - Ads — Box Numbers
  - Ads by Taker
  - Other
- Classified Accounting
  - Billing
  - Killed Ads
  - Payroll
- Copy Flow Charts
  - Editing Points
  - Process Flow
  - Create Points
  - Output Points
- Hardware Documentation
  - Functional Specifications
  - Theory of Operation
  - State Diagrams and Equations
  - Wire Lists
  - Mechanical
  - Parts Lists
- Operator Manuals
  - General
  - Mark-up
  - Setting Samples (eleven categori
- Site Preparation
  - Utilities
  - Environment
  - Physical

- Maintenance
  - Method
  - Response
- Backup Procedures
  - Power Fail
  - Computer
  - I/O
  - Duplication of Equipment
  - Levels
  - Telecommunications
- Cost
  - Hardware Details
  - Options
  - Software Details
  - Options
  - Training
  - Installation
- Current Vendor Installation List

E. TYPESETTER

- Method of Character Storage and Sizing
  - Characters per Style
  - Number of Styles
  - Standard Character Set for Each Style
  - Optional Characters
  - Pi Characters from Existing Library
  - Pi Characters from Designs Supplied
  - Time for Matrix Change
  - Separate Pi Exposure System
  - Time for Pi Mat Change
  - Printers' Ability to Manufacturer Pi Mats
  - Size Range
  - Number of Sizes
  - Additional Sizes
  - Time to Change Additional Sizes
  - Method of Sizing
- Set up Commands
  - Line Length Maximum/Minimum
  - Line Length Increments
  - Leading Minimum and Maximum Value (programmed, standard, end of line)
  - Point Size (Vertical Height)
  - Set Width (Horizontal Width)
  - Upper Case and Lower Case
  - Addition Lead (one shot)
  - Zero Lead (one shot)
  - Immediate Lead (one shot)
  - Oblique Image
  - Embolden Image
  - Condense Image
- Lighten Image
- Expand Image
- Maximum Amount of Text That Can Be Set in One Operation (take length)
- Mixing Typefaces Within a Line
- Mixing Pi Characters Within a Line
- Quadding and Insert Commands
  - Quad Left
  - Quad Right
  - Quad Center
  - Ragged Left
  - Ragged Right
  - Ragged Center
  - Quad Middle (insert blank)
  - Insert Leaders Non-aligned (Em, En, 6 dot, 3 dot, Period Leader)
  - Insert Leaders Aligned (Em, En, 6 dot, 3 dot, Period Leader)
  - Insert Characters Defined X Non-aligned
  - Insert Character Defined X Aligned
  - Insert Rule
- Multijustification Commands
  - Set Tabs/Multijustification/# Points/Columns
  - Set Tabs to Text
  - Set Tabs Proportionally
  - Set Text Tabs Stop
  - Begin Tab
  - End Tab
  - Tab Left
  - Tab Right

- Tab Center
- Justify Tab
- Insert in Tab
- Tab Around
- Tab Text

Space Commands
- Automatic Letterspace When Maximum Word Space Equals X
- Manual Letter Spacing
- Automatic Kerning
- Manual Kerning
- Automatic White Space Reduction
- Zero Set
- Figure Space
- Fixed Space
- Relative Space
- Interword Space
- Em, En, Thin, Hair Space
- Set Average Interword Value
- Set Maximum Interword Value

Vertical Displacement Commands
- Reverse Leading
- Baseline Jump (deflection from baseline)
- Superior (High Aligned)
- Inferior (Low Aligned)
- Return to Marked Point in the Text

Vertical Justification Commands
- Vertical Justification by Points or Specified Unit
- Vertical Justification by Lines

Indent Commands
- Indent Left
- Indent Right
- Indent Center
- Multiple Indent
- Hanging Indent
- Indent to Text

Overset Commands
- Hanging Punctuation
- Supplementary Line Length (defined value)
- Overset Left (undefined value)
- Overset Right (undefined value)

Format Commands
- Create Format
- Store Format
- Use Format
- Change Format
- Chain Formats
- Nest Format

Skew Commands
- Skew Left (QR Down◥)
- Skew Right (QL Down◤)
- Skew Centered (QC Down▼)
- Reverse Skew Left (◢)
- Reverse Skew Right (◣)
- Reverse Skew Center (▲)

Run Around Commands
- Delay Command
- Delay Execute
- Runaround Left
- Runaround Right

Area Make-up Commands
- Define Number of Lines Mark X
- At X insert Y
- X Not to be Less Than % of Line Length
- X Not to Be a Heading or ‘n’
- Define Number of Points (inches, etc.) Mark X
- If X Is Less Than Normal Subdivision, Insert Multiples of ‘N’ at ‘n’

Hyphenation Commands
- Discretionary Hyphen
- Obligatory Hyphen
- Automatically Generated Hyphen
- Logic Rules Only
- Logic Rules and Exception Dictionary
- Exception Dictionary Only
- Hyphenation Language Change and Reset
- Specify Maximum Interword Space at Which Point the Desired Hyphenation Takes Place
- Specify Maximum Interword Space at Which Point Letterspacing Occurs in a Hyphenated Line
- Specify the Number of Letters Preceding

- and/or Succeeding a Hyphenation Point.
- Inhibit Hyphenation
- Maximum Hyphenated Lines in Sequence
- Disable Hyphenation for the Next Word
- Automatically-Generated Headers
  - Slug Line Film/Paper
  - Tag Line Film/Paper
  - Output Device
- Miscellaneous Temporary
  - Drop Initial
  - Raised Initial
  - Multi-Flash
  - No Flash
  - Automatic Ligatures
  - Automatic Generation of Fractions (Not in standard matrix) Generate from Superiors and Inferiors
  - Horizontal Rule Generation
  - Vertical Rule Generation
  - Automatically Cuts Film/Paper on Command
  - Automatic Small Capitals by Size Reduction
  - Punching of Visual Coding
  - Control Over End of Take Paper/Film Feed
- Input
  - 5-, 6-, 7-, 8-Level Paper Tape
  - Advanced or Center Hole Sprocket
  - Magnetic Tape 7 or 9 track Industrial Compatible
  - Recording Format for Above
  - Magnetic Cassette Tape
  - Recording Format for Above
  - On-line Operation Specifying to Which Device
  - Floppy Disk
  - Recording Format for Above
  - Input Justified Zonally or Precisely
  - Input Unjustified
  - Conversion of Wire Service Tape Line Length
- Density Control
  - Automatically Selected from Preset Values by Typestyle
  - Automatically Selected from Preset Values by Point Size
  - Manual Adjustment Specifying Amount and Area of Adjustment
  - Film and Paper Setting
- Speed
  - Newspaper Lines Per Minute Specified by Manufacturer
  - Characters Per Second Specified by the Manufacturer
  - Area Speed Specified by the Manufacturer
  - Speed or Representative Samples of Work to Be Produced Supplied by the Prospect
- End Product
  - Film or Paper
  - Maximum and Minimum Dimensions Handled
  - Material Wastage Fore and Aft
  - Time Taken to Change or Reload with New Material of the Same and Different Dimensions
- Maintenance and Training
  - Training School Location and Type of Personnel (i.e., operators, technicians)
  - Nearest Service Department; Number of Trained Staff Relevant to the Equipment in Question
  - Service Contract
  - Recommended List of Spare Parts
  - Recommended List of Test Equipment
  - Recommended List of Auxiliary Equipment
  - Type of Logic
  - Type of Internal Computer
  - Power Consumption
  - Heat Dissipation
  - Environmental Requirements
  - Physical Utility
- Dimensions

CHAPTER EIGHTEEN

EXCEPTION WORD DICTIONARY CONCEPTS

Due to the complexity of the rules, the numerous exceptions to the rules, homographs, and other idiosyncrasies, the English language is difficult if not impossible to hyphenate by rules alone. To overcome these shortcomings, most electronic composition systems support the rules with an Exception Dictionary. An Exception Dictionary is a list of words correctly hyphenated which would not normally be hyphenated satisfactorily by the logical rules. The Exception Dictionary is stored, usually on magnetic disk, in the computer system. When the justification routine reaches a point where it needs to hyphenate a word, it first searches through the Exception Dictionary to ascertain whether or not the word exists there as an exception. If it does, then the appropriate hyphenation point is selected and a hyphen is inserted in the word. If the word does not appear in the Exception Dictionary then the hyphenation point is determined by the hyphenation rules.

In addition to the words which need to be placed in the Exception Dictionary with the correct hyphenation points indicated, words which should not be hyphenated can be entered and stored. Proper names, place names, etc., can be added to the Exception Dictionary without hyphenation points; this will prevent them from being hyphenated by the logical rules. It is also possible to enter and store word roots, prefixes, or any part of a word or words in the Exception Dictionary. Although these portions of a word will often form part of the logical rules used to hyphenate a word, it is still possible to store them in the Exception Dictionary if necessary.

Ultimately, it is possible to develop an Exception Dictionary so that it does not require the support of logical rules. The disadvantages of an Exception Dictionary are:

1. Speed
2. Cost of Storage

The speed of an Exception Dictionary is related to many factors. When the justification routine reaches a point where it needs to hyphenate a word, the first thing it has to do is locate the word in the Exception Dictionary. The search time is determined by the size of the Exception Dictionary, the method by which the Dictionary is stored, and the efficiency of the search routine. Obviously, the bigger the Exception Dictionary the longer it will take to search through it. Equally, this task will take longer if the Dictionary is stored on magnetic tape, which has to be searched and moved serially, as opposed to magnetic disk, where it is possible to locate or access information directly. The actual method used by the software to locate a word can also affect the speed. The slowest method is to take the letters of the word to be hyphenated in sequence and compare them sequentially to the words stored in the main computer memory or core.

The word list contains the key characters and their computer locations or addresses. Because the list 'maps out' the location, it is referred to as a 'bit map'. When a word needs to be hyphenated, the word is compared to the key references in the bit map and when a match is made, it immediately goes to the location or address of the key in the Exception Dictionary. This method eliminates the time-consuming process of searching through the complete Exception Dictionary. Keys can consist of the twenty-six letters of the alphabet and any other significant combination of letters. Due to its size, an Exception Dictionary costs more to store than a set of logical rules. A set of logical rules can require as little as 250 16 bit words, which cost less than $1000. Typically the cost of the software for logical rules is approximately $2000.

An Exception Dictionary can be of any size, but typically it has 5,000 to 10,000 printing words and requires disk storage. A disk system costs approximately $8000, and the software approximately $2000.

The advantage of an Exception Dictionary is its ability to produce hyphenation which will meet the requirements specified for hyphenation accuracy. Hyphenation achieved with logical rules and an Exception Dictionary is of a much higher standard than hyphenation achieved with logical rules alone.

The Exception Dictionary can be extended to include multiple levels which cover specific requirements. For example:

1. System Exception Dictionary
2. Job Exception Dictionary
3. Operator Exception Dictionary

The System Exception Dictionary is used by the system for all work produced in the language on which the Dictionary is based. A secondary Job Exception Dictionary is specifically compiled to be used in conjunction with a particular work being set. The particular work or discipline, whether legal, medical, or scientific, has words which are not frequently used in normal everyday language. These words constitute the Job Exception Dictionary. A third level is the Operator Exception Dictionary, which consists of words required for a specific job currently being processed. The sort of words stored would be place names, proper names, etc., used frequently in a particular job.

Following is an example of a main System Exception Dictionary. It contains approximately 7000 entries. The entries consist of:

1. Words with their desired hyphenation points
2. Words not to be hyphenated
3. Word roots
4. Prefixes

It is designed to work independently of logical rules. Consequently it can can be reduced in size should a set of logical Hyphenation Rules be used.

Several entries of the same word root may be encountered in the Exception Word Dictionary. Several entries of a frequently encountered word may be useful in improving the look-up speed. The entries may not be in alphabetical order since additions might be added at the end of a section without realphabetizing the dictionary. The entries are marked with a slash (/) to show possible end line hyphenation and a hyphen (-) to indicate the preferred place for end line division.

A

ab
aba-cus
aban-don
abas
abase
abat
abate
ab/bey
ab/bre-via
ab-di
ab/di-cator
ab-duc
ab-er
ab/er-rant
abet
abey
ab/hor
ab/horred
abid
abilit-ties
abil-ity
ab/jec-
ab/late
ab/la-tion
ab/lu-tion
ab/nor
ab/nor-mali-ties
aboard
abol
abomi-nable
abor
abor-tion
abor-tive
abound
about
above
above-mentioned
abra-
abreast
abridg
abridge
abroad
abrupt
abrup-tion
ab/scess
ab/scond
ab/scen
ab/sent
ab/sen-tee
ab/sen-tee/ism
ab/sent-ing
ab/so-lute
ab/so-lutist
ab/sor-bent
ab-sorp-
ab/stain-ers
ab/sti-
ab/stract
ab/strac-ted
ab/strac-tion
abun-
ab/surd
abu-sive
abut
abut-ting
abys
ac
aca-demi
aca-demi-cal
aca-demi-cally
acad-emy
accel-er
ac/cen-tu
ac/cept
ac/cepta-bility
ac/cep-ta-tion
ac/cess
ac/ces-sibility
ac/ces-sion
ac/ci-den
ac/cla-
ac-claim
ac/cli-mat
ac/com-mo
ac/com-pa-nist
ac/com-pany
ac/com-plish
ac/cord
ac/cor-dance
ac/count
ac/crual
ac/crue
ac/cu-mu
ac/cu-rate
ac/cus-tom
achiev-
achieve-ment
ac/knowl-edge
acous-
ac/quaint
acqui-esce
ac/quire
ac/quir-ing
ac/quit
acro-
acrop-olis
acrylic
act/ing
ac/ti-vate
ac/ti-va/tion
ac/ti-vate
ac/ti-vator
actor
ac/tual
ac/tu-ally
ac/tu-ate
acute
ad
adage
ada-mant
adap
adapt-able
adapt-ive
ad/den-dum
ad/dict
ad/dic-tion
ad/dress
ade-quate
ad/her
ad/he-sion
ad/he-sively
ad/ja-cent
ad/join
ad/journ
ad/judg
ad/judge
ad/ju-di
ad/just
ad/min
ad/mi-ra/ble
ad/mi-ral
ad/mire
ad/mis-sion
ad/mit
ad/mon
ad/mo-ni
ado-lescen
adopt
adop-ti
ador
adorn
adul-ter
ad/van
ad/vanc
ad/vance
ad/ven
ad/ver
ad/verse
ad/vise
ad/vis
aegis
aer
aera-ting
aer-ial
aero
aes-thetic
af/fec
af/fect-ing
af/fec-tive
af/fili
af/flict
af/flic-tion
af/flu
afoot

afoul
afraid
after
against
ag/gra
ag/gre
ag/gres
ag/gres-sion
ag/nos-tic
ag-on
agrar-
agree
agri-business
air
album
al/co-hol
alien
al/le-
al/le-ga-tions
al/lege-able
al/le-giance
al/le-vi
al/li-ance
al/lit-er
al/lo-cat
along
al/lot
al/low-able
al/lur
al/lure
al/lu-sion
al/lu-sive
already
alter
al/ter-na-tive
alti
al/to-gether
alumni
am
amal-ga
ama-teur
amaz
amaze-ment
am/a-zons
am/bas-sa
ambi
am-bigu-
am/bi-tio
am/bi-tious
am/bu
am/bush
amend-able
amend-ment
ame-ni
ame-nity
ami-able
amid
am/mu
am/ne-sia
am/nesty
am/pli
am/pu
amus
amuse
amus-edly
an/aes
anal
analo-gous
anal-ogy
analy-
anat
anath-ema
angel
an/gles
an/gri/ly
angry
an/gu
an/guish
ani-
an/ni-hi-late
an/ni-ver-sery
an/no-
an/nounce
an/noy
an/nual
an/nu/ally
an/nul-ment
an/nun
an/nun-ci
anoint
anom-al
anom-aly
ano-nym-ity
anony-mous
an/other
an/swer
an/tago-nist
ante-
an/tho
an/thro
anti-
an/tici
an
ant/ler
anxi-ety
anx-ious
any
ap
apa-
apart
aper-i-tif
ap/er-ture
aph/ro
api-
aploma
apo-
apolo
apo-logue
apos-
apos/tle
ap/par
ap/peas-ing
ap/pen
ap/per-tain
ap/pe-tite
ap/pe-tiz
ap/pli
ap/prais
ap/pre-cia-ble
ap/pre-ci-ate
ap/pre-hen
ap/pro-pri
ap/proxi
apri-cot
aqua
aquar-ium
aquatic
aque-duct
ar
ara-besque
arable
ar/bi-
arch
ar/chae-
ar/chi
ar/chi-pel-ago
archi-tect
arch-way
arc/tic
ar/du-ous
ar/gu
aris-to
ar/is-toc-racy
arith
arm
ar/ma
ar/mies
ar/mis-tice
around
arousal
arouse
ar/ro-gan
art/ful
ar/ti
ar/ti-cle
ar-ticu-
art/less
ar/til-lery
ar/tis
art-istry
as/bes-tos
as/cen
as/cer-tain
as/cribe
as/crip
ash-
asham
ashamed
ashore
ask
askance
as/phyxia
as/pire
as/pir-ate
assay
as/sem-blage
as/sen-ta-tion
as/ser-tion
as/si-du-ity
as/sidu-ous
as/sig-na-tion
as/simi
as/sim-i-late
as/so-ci/ate
as/sum
as/sump
as/suredly
as/sured-ness
astern
asthma
as/ton-ish
as/trol
as/trol-oger
as/tro-logi-cal
as/tron
as
asun-der
asy-lum
asym-met
asym-met-ri-cal
at
athe-ist
ath-let
at/mo
at/mo-spheri
atom
atomi-cally
atone
aton-ing
atro-cious

at/tach
at/tack
at/tain
at/tempt
at/tend
at/ten-tion
at/ti-tude
at/tor-ney
attorney-at-law
at/trac-tion
at/tri
au/burn
auc/tion
aud
audi
au/dio
aug
au/gust
aus
autho-
au/thor
auto
auton
au/topsy
autumn
aux-il-iary
ava
avail
avar
aver
averted
avi
avo
avow
avoid
awak
aware
awe
awk

B

bab
bab/ble
ba/boon
bac/ca-lau-re/ate
bache-lor
back
backup
bac-teri
bac-te-rio
bad
bad/get
baf/fle
bag
bag/ged
bail
bait
bak
bake
bala
bal-anc
bald
ball
bal/lad
bal-last
bal/ler-ina
bal/let
bal-lis
bal-loon
bal/lot
balk
balmi
bal/sam
bal-us
bam
ban
ba/nana
band
ban-dage
ban/dit
bang
bank
ban/ned
bap
bar
barbed
barb-less
bare
barely
bari
bark
barn
bar-na-cle
baro-metric
baron
bas
base
bash
basi
basing
basked
bask-ing
bast-ing
bat
batch
bath
bats
battle
baulk
bay
be
bea
beach
bea/con
bead
beaker
beam
beamer
bean
bear
beard
beat
beau-ti
beau-tics
bed
beeches
bees
beet
beetle
beg/gar
beg/ged
bel
belched
be-lie
be-liev
bell
bellies
bel/low
bel-liger
be-long
belt
ben
bench
bended
be/neath
beni
be-nighted
be-nign
bend-ing
ber
ber-ries
ber-serk
berth
be/stir
bet-ting
bet/ter
bev
bib
biblio
bid
big
bil-berry
bil-ious
bill
bil/let
bil-lion
bil/low
bin
bind
birth
bis-cuit
bishop
bit
bitu
biv-ouac
bi/zarre
black
blad
blam
blame
bland
blank
blar
blas
blast-ing
blaz
bleach
bleari
bleat
bleed
blem
blend
bless
blind
blink
bliss
blis-ter
blithe
bliz
bloat
block
blood
blood-ily
bloom

blos-som
blot
blotch
blouse
blow
blown
blub
blue-print
blun
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blur
blus
blush
board
boast
boat
bob
bob/bed
bob/ble
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bodi
bod/ice
body
boil
bois-ter
bol
bold
boll
bolt
bom
bom-bard/ing
bombed
bomber
bomb-shell
bomb-sight
bon
bond
bond-ing
bonds
book
boom
boost
booster
boot

booths
bor
bore
bor-ough
bosom
bosses
bot
botch
bother
bot/tle
bound
boun-ti
bow
bowled
bowler
bowling
box
boy
brace
brack
brag
brain
brais
brass
bras-sieres
brass-i-ness
brav
bra-vado
brave-hearted
bread
breadth
break
breast
breath
breech
breed
brev-ity
brew
brib
brick
bride
brides-maid
bridg
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brighten
brightly
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brist-ling
Britain
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broad
bro-cade
bro-chure
brogue
broken
broker
bron
bronzed
bronz-ing
brood
broom
brother
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brut-ality
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brusque
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buc-ca-neer
buck
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bud/get
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buffers
bug
bug/ger
bugler

bu/gling
build
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bulb-let
bul-bous
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bullies
bul-lion
bully
bumble
bum-bling
bump
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bungle
bunk
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bur
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C

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can-didly
can-di-date
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carv-ing
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chip
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Christ-mas
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coco
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cog
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coin-age
coin-ing
col
cold
colonel
colo-nial
color
co/los-tomy
collier
colt
colum
com
coma
combed
come
come-li-ness
comely
com-fort

comi
com-mo-dore
com-mu-nis
com-mu-nal
com-pass
com-panies
com-pany
com-ple-men
com-pro
comp-to-meter
con
con-ned
con/di-tion
con/fed-er-ate
coni
coni-fer
conning
con-quer
con-quest
con/se-quen
con/se-quence
con/se-quent
con/su-lar
cook
co/op-er
co/or-di
cop
copi
co-pilot
copu
copy
cor
cord-age
corded
cordi
cork
coro-ner
cor-re-spon-den
corn-field
corn-flour
corpse
cos
costing
cost-li-ness
costly
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co-tillion
cou-gars
could
coun
counted
counter
counties
count-ing
count-less
coun-try
coup
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cour-te-ous
cour-tesy
cousin
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covet
cow
cox
crab
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craft
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curs-ing
cur-sory
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cuss-ed-ness
cushion
cut
cute
cuttle
cu/ti-cle

D

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de/ceiv
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deck
dec-or
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de/form
de/for-ma-tion
deft
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Deirdre
dele-ga
dele-ga-tion
de-lib
deli-cac
deli-cacies
deli-cate
del-uge
dely
dema-gogue
de-mar
demi
demo
democ-racy
de/mon
dem-on-strat
dem-on-strati
de/moral
den
de/nied
de/nomi
dense
dente
de/nu-mer

de/nun-ci
deny
de/odor
de/oxi
de/part-men
de/pos-i
de/pri-va-tion
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depu
der
de/railed
de/riv
des
des-cend
de/scrip
desert
de/serv
des-ic
deso
des-patch
des-per
de/spon-dency
des/sert
des-ti
de/tec
de/tect-able
de/ten
de/ter
de/te-rio-ra-tion
de/terred
de/tri-men
dev-as
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de/valu
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de/velop
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de/void
de/vote
de/vo-tion
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di
dia
di/ag-on
di/ag-nos
di/alled
dia-logue
diary
diar-ies
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diesel
diet
differ
diffi
dif-fi-cult
dif-fus
dif-fu-sion
dig-ger
dig-ging
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di/lap-i
dim
dimple
din
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dingi
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dip
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di/rec/tor
dirti
dis
dis-agree
dis-al-low
dis-ap
dis-ar
dis-armed

dis-con
dis-crimi-nati
dis-hev/al
dis-hev/eled
dis-order
dis-pro
dis/prove
dis-sat
dis-semi
dis-solv
dis-tress
dis-em
dis-en
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ditch
dither
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div
di/ver
di/vert-ible
di/vert-ing
di/ver-sely
divi-dend
divi-na/tion
di/vulge
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di/vulg-ing
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dob/bin
doc
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dock
doc/tor
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dog-mati
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dom-esti
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dowa-ger
dowdi
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dows
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drab
drag
dragged
draggle
dragon-fly
dra-goon
drain
drama
dra-matic
dra-mati-cally

dra/ma-tis
drap
dras-ti
draughts
draw
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dread
dream
dreami-ness
drear-ily
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dredg-ing
drench-ing
dress
drift
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drink
drip-ping
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drive
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E

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ele-men
ele-phant
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eleven
elfish
elixir
Eliza-be-than
elon-gate
elon/ga-tion
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elope
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el-igi
eli-gible
eli-sion
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elo
else
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eman-ci
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em/bar
em/barked
em/bass
em/bed
em/bez/zle
em/boss
em/brace
em/broid
em/bry
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emerg
emer-ging
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emiss
emis-sion
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emo-tion
em-pire
em-ploy
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emul-si
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en/camp
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en/chan-tress
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Eng-land
Eng-lish
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en/joy
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en/quir
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en/tan-gling
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enti-ta
enti-ties
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envi-sion
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epi-demi
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epit-om

epit-omi-cal
epoch
equa
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equaled
equal-ity
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eques
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equipped
equip-ment
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equiv
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eras
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erectly
erect-ness
erod
eros-ive
erotic-ism
erot-ism
err-ability
er/rancy
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eru-dite
eru-dition
erupt
ery
eryth-ro
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es/ca-lat
es/ca/la-tion
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es/ca-pade
es/cape
es/ca-pology
es/chew
es/cort

eso-teri
es/pe-cial
espion
es/pla-nade
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ethi-cal
eth-ni
eti-quette
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Europe
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eu/tha-na/sia
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evap-or
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eventu
ever-last
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evin-cive
evis
evo
evoc-ative
evo-ca-tory

evok
evol
evol-ute
evo/lu-tion
evolve-ment
evolv-ing
evul-sion
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ex/ac-er
exact
ex/ac-tion
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exag-ger
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exalted
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ex/clu-sion
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ex/cre-ment
ex-cru
ex-cur
ex-cus

ex/ec-u/tant
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exert-ive
exhaus
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ex/hil-ar
exhor
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expand
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ex/ul-ta-tion
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F

fab-ri
fabu
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fad-di
fade
fading
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fagged
fail
faint
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faith
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father
fathomed
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fatu-ous
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favor
fawn
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fic-tion
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field
fields-man
fiend
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fife
fif-teen
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fig-ment
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fillet
filling
film
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finale
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fi/nan-ci
finance
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finely
finery
finger
fi/nesse
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fin-ished
finn
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fire
fir-ma
firmly
firm-ness
first
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fit
fitz
fix
fixa-tive
fix-ture
fizzle
fiz/zling
flabby
flag

flagel
flagged
flagon
fla-gran
flam
flam-boy
flame
fla-mingo
flan
flange
flank
flap
flapped
flare
flash
flask
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flatter
flatu
flaunt
flavor
flaw
flax
flea
fledg
fleece
fleet
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flex
flexi-bil/ity
flick
flick-er
flight
flim-sily
flinch
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flip
flipped
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flirted
flirt-ing
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float
flock
flog
flogged
flood
floor
flop
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flu-or
flur-rie
flurry
flush
flute
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folk
fol-licu
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food
fool
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force
forc-ib
ford
fore
forego
for-eign
fo/ren-sic
for-ever
forge
for/get
fork
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forth
fort-night
fos-ter-age
fought
foul
foun
found-ling
foundry
four
fourth
fowl
fox
fra
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frag
fra-grance
fra-grantly
frail
frame
fram-ing
fran
frank
frat
fraudu
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freight
fren-zied
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fre-quen
fre-quently
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fron-tier
frost
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fugi
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fulmi
fume
fun
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fun/gus
funny
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furi
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furry
fur/ther
fus
fusil

G

gab-ar
gab/ber
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gad/get
gaf/fer
gag-ging
gai/ety
gain
gal
ga/lac
gal-lan
gal-lantly
galled
gall-ing
gall-stone
ga/lor

ga/losh
gam
gamble
game
ga/meti
ga/meto
gaming
gamo
gan
gang
ganglio
gan-grene
gar
garbe
garble
gargle
garish
gar-nish
gas
gas-eous
gash
gasi
gaso-line
gasp
gate
gath-ere
gath-er/ing
gaud-ily
gaudi-ness
gaunt-let
ga/votte
gay-ness
ga/zelle
ga/zette
gazet-teer
gear
gel/ate
gela-tine
ge/la-tion
gel-ig-nite
gem
gemi
gem-ini
gemmed
gen
ge/ne-al-o-gi
ge/ne-al-o-gist
ge/ner
gen-eral
gen-eri
geni
ge/nial
ge/nius
geno
gentle
gently
genu
ge/nus
geo
ge/og-raphy
ge/olo-gist
ge/ology
ge/ome-try
Georgette
ger
ger-mi
germ-proof
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ges-ticu
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ghast
ghost
ghoul
gib
gib-ber
gib-bing
gid
gigan
gig-gling
gild-ing
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gin/ger
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girdle
girl
girth
give
giv/ing
giz-zard
glaci
glacial
gla-cier
glad
gladi
glam
glam-or
glan
glance
glanc-ing
glass
glassi-ness
glau
glaz
gleam
glean
glee-ful
glid-ing
glim-mer
glimps-ing
glint-ing
glisten
glit-ter
glo
gloaming
gloate
gloat-ing
globes
globu
glob-ule
glock
glom
gloom
gloomi
glo-ri
gloried
glori-fi-cation
gloss
glossi
glow
glower
glove
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glu-ti-nous
glut-ted
glut-ting
glut-ton
gly
glycer
glyp
glyph
gnaw-ing
goad
goal
goat
gob
gobble
gobi
god
gof
gog-gling
go-ing
gold
goldi
gol-li-wog
gom
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gono
gon-or
good
goos
goose
go/pher
gor
gorge
gor-geous
gorily
gos
gos/sa-mer
gos-sip
goug-ing
gou-lash
gour
gout-ily
govern
gov/ernor
grab
grabbed
grace
gra-cious
gra-date
gra-da-tion
grada-tory
gra/di-ent
gradu
grad-ual
gra-dus
graft
grain-ing
gram-mar
gram-mati
gramo-phone
grand
grandeur
gran-di-ose
granger
gran-ite
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gran-ule
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graphi
graph-ite
grapho
grapple
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gra-tu
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gra-vell

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grav-ity
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greet-ing
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grem-lin
gren-ade
grena-dier
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grief-stricken
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grim
grimi-ness
grind
grin-ning
grip-pers
grip-ping
gris-li-ness
grit-ting
griz-zling
griz-zly
grocer
grog
groom
grooms
groov-ing
gross
gro-tesque
ground
grounds
group-ing
grous-ing
grout-ing
grovel
grov-elled
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gruel
grug
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grumble
grumpi
grunt-ing
guar-an
guard-ian
guards
guer-rilla
guess
guest
guid
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guild
guil-lo-tine
guilt
guitar
guilti-ness
gul-let
gull-ibil-ity
gull-ible
gul-lies
gul-ping
gum
gump-tion
gun
gunned
gun-wale
gurg
gurgi
gurgle
gush-ing
gust-ily
gusti-ness
gut
gut/ter
gym
gym-nasium
gym-nas-tic
gynaf
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gyp
gypsies
gy-rat
gy/ra-tion
gyro
gy/rus

H

hab-er
ha-bili
habit
habi-tant
habi-tat
habi-tation
ha-bit-ual
ha/bit-u-ally
hack
had
hae
hag
hagged
haggle
hag-gler
hail
hair
hal
half
hali-but
hall-mark
hal-luci
hall-way
halo
halt-ingly
haly
ham
han
hand
handle
handi
hand-ily
handy
hand/ker
hang
hangar
hanker
hap
happy
har
hard
hardi-ness
harem
harm
har-mon
har/mo-ni-ous
harp
har-poon
harried
harsh
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hatch
hate
hau
haugh
haul
haulier
haunch
haunt
hav
having
haw
hawk
hay
haz
hazel
hazi-ness
hea
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heaven
heav-ily
heavi-ness
heavy
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heckle
hec-to
hedg
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heed
hefty
heighten
hei-nous
heir
hel
heli
he/lio
hell
hello
help
hem
hema
hemi

hemmed
hemo
hem-or-rhage
hemp
hen
hence
hench
hep
her
herb
her-ba/ceous
her/bi-cide
herd
herds
here
her-edi
her-eti
heri
heroes
hes
hesi
hess
het
hether
hew
hex
hexa-gon
hexa-hedr
hi/ber
hic
hick
hi/er-arch
hi/er-arch-ism
hiero
hid
hide-bound
hide-out
high
hil
hill
him
hind
hinder
hip
hipped
hire
his
hiss
his-tori
his-tri
hith/er
hit/ter
hit-ting
hoar
hoard
hoari
hoarse
hob
hobble
hob-bler
ho/cus
hog
hogged
hogs-head
hol
hold
hole
holi
holi-day
hol-low
holly
hom
home
homi-cid
homing
homo
hon/est
honey
honor
hood
hoo-doo
hoof
hoo/li-gan
hoop-ing
hoo-ray
hop
hope
hope-ful
hopped
hor
hor-izon
hori-zon-tal
horn
hor-net
horse
hor-ti-cul
hos
ho/sier
hosing
host-ess
hot
hotch
ho/tel
hour
house
hous-ing
hov-er-ing
how
howle
hub
hubbed
huckle
hud-dling
hug
huge
hugged
hulk
hu/man
hu/mane
hu/mani-tarian
hu/mani-ties
hu/manity
humble
hum-bling
hum-bug
hu/mer
hu/midi
hu/mid-ify
hu/mid/ity
hu/mili
hum-ming
humor
hump
hu-mus
hunch
hun-dred
hun/ger
hun/gri
hunt
hunts
hur
hurd
hurdle
hurle
hurry
hurt
hurtled
hus-band
hush-ing
husk-ily
huski-ness
hus-tler
hus-tling
hut
hya/cinth
hy/ae/na
hy/brid
hy/brid-ity
hydra
hy/dran-gea
hy-drant
hy-drate
hy-dration
hy/drau-li
hydro
hydrox
hy/ena
hy/gien
hy/gieni
hy/gro
hym
hyme
hy/men
hyp
hy/per
hy/peri
hy/phen
hyp/not
hypo-chon
hypoc/risy
hyp-o-crite
hyp-o-criti
hy/po-derm
hy/pot-en-us
hy/poth
hy-po-theti
hys
hys-teri
hys-ter-ics

I

iam
iatri
iatro-
ibi
ic
ice
ich
ich-no
ich-thy
ich-thyo-sau
ici
icicle
icon
icono-clas

ideal-is
ideal-istic
ident
iden/ti/fi-cation
ideo
ide/og-raphy
ide/ol-ogist
ide/ol-ogy
idio
idi-ocracy
idio-cy
idi-om
idi-om-atic
idi-opathy
idio-syn
id/iot
idi-oti
idiot-ism
idle
idol
idyl
ig
ig/nom
ig/nor
iguan
il
il/le-git
il/limi
il/lit-er
ill-ness
il/logi
il/lu/mi-nat/ing
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il/lus
il/lu-sion
il/lu-sive
il/lus-tra-tive
im
im/ag-ery
imag-inary
imag-ine
im/ag-ism
im/be
im/bri
imi-ta-bility
imi-tat
imi/ta-tion
im/i-ta/tor
im/ma
im/mac-u
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im-mea-sur
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impas-si-bility
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in
in/ac
in/ad
in/alien
in/alter
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in/ap-pli
in/ap-pre
in/ap-pre/cia
in/apt-ness
in/ar
in-as-much
in/at-ten
in/audi-bility
in/au-di-ble
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in/aus
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in/cal
in/can
in-capa-bility
in/capable
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inch
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in/fluence
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in/for-mant
in/formen
in/form-ing
in/furi
in/geni
in/habi
in/hab-it-able
in/har
in/hos
in/imi
ink
inn-keeping
inno
in/nocu-ous
in/noxious
in/nu
in/nu/mer
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in/sinu-ator
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in/struc
in/stru-men
in/sub
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in/sur-ance
in/sur-ing
in/sus
in/teg-rity
in/tel-li
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in/tend
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inter
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in-tern-ally
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in/ter-pret
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in/toxi
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in/ven
in/vent-able
in/ver
in/vert
in/ves
in/vest-ment
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in/vig-or
ir
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ir/re
ir/rec
ir/re-cover
ir/regu
ir/rel
ir/re-ligio
ir/rep-a-rable
ir/re-sol
ir/res-olv
ir/re-spec
ir/re-spon
ir/rev-eren
ir/revo
ir/ri
island
iso
iso/chro
issu
itali
iter
itin
it/self

J

jacob
jaco-bean
jaco-bite
jade
jag
jagged
jail
jam
jammed
jangl
jan-gling
jani
janu
Japan
ja
jab
jabbed
jac
jack
jackal
jacket
jar
jarred
jas
jaun
jaunt
jaun-ti-ness
jaw
jay
jazz
jeal
jeer
jel
jem-mied
jemmy
jeop
jer
jerk
jest
jesu
jet
jetted
jew
jew-el-ers
jew-elry
jib
jibbed
jiffy
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jin
jingle
jin-gling
jingo
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job
jo/cund
jo/cun-dity
jodh
jog
jogged
joggle
join

joint
joist
jok
joke
jolly
jolt
jostle
jot
jour-nal
jour-ney
joust
jovi-ality
jov-ial
jov-ially
joy
ju
ju/bi
judg
judge
ju/di-cat
ju/di-cature
juggle
jug-gler
jug-gling
jugu
juice
juic-ily
juici-ness
juke
jumble
jump
junc
jungle
ju/nior
juni-ority
ju/ni-per
junk
jur
juries
juror
jury
jus
just
jus-tice
jus-tifi
jus-tify
jut
jutted
juv-en
ju-ven-ilia
jux-ta
jynx

K

ka
ka/lei-do
kan-ga
kao
kara
kary
kash
kata
kayak
ke
kedge
kedg/eree
keel
keen
keep
keeper
ker
kerb
kern
ketch
kettle
key
kick
kid
kid/dle
kil
killed
killer
kill-ing
kiln
kilo
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kin
kind
kin/der-gar-ten
kindle
kin-dler
kin-dling
kin-dred
king
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kins
kiosk
kip
kirk
kirtle
kiss
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kitch
kitch-ens
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kit/ten
kit-ties
klep-to
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kraal
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ky-mo

L

la
lab
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la/belled
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lace
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ladies
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la/goon
laird
lake
lam
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lam-baste
lam-bency
lam-bent
lam-bert
lame
la-ment
la/men-table
lam-en-tation
lami
lam-i-nable

lamp
lam-poen
lam-poon
lam-prey
lan
lance
lan-cet
lanc-ing
lance
land
laun-dr
lands-man
lan-guage
lan-guid
lan-guish
lan-guor
lap
la/pel
lappi
lapped
laps
lapse
lar
lar-cen
larch
lard
lar/der
lar/don
larg
large
lark
larva
laryn
lar-ynx
las
las-civ
lash
lasses
lasso
last
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late
laten
late-ness
lat-eral
lat-erally
lath
lather
lati
lati-tudi
laud
laud-ability
laugh
laun
launch
laur
laurel
lau-relled
lav
lava-tories
lava-tory
lave
lav/en-der
law
lawn
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laxa-tive
laxa-tor
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leas-able
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lech-er-ous
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lega-cies
legal
legend
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legion
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lei-sure
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lemon
lemur
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length
lengthi-ness
le/nience
le/nient
lens
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leop-ard
lep
leper
lepi
lep-to
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lev-elled
lev-er-ling
lev-el-ler
lever
lev-eret
levi
levied
lev/ity
lew
lewd
lexi
li
liabi-lity
liai-son
li-bation-
libel
libelled
lib-er
libret
libret-tist
licit
lick
lid
lieu-ten
life
lift
liga-men
liga-ture
lig
light
like
likened
lil-lies
lilt
lim
limb
lime
lim-er-ick
limi
lim-it-able
limi-tation
lim-ited
lim-it-less
limp
lim-ou
lin
line
lin-eal
lin-ea-ment
lin/ear
lin-ear-ity
ling
linger
lin-ge/rie
lingu
lin-gual
lin-guis
lini-ment
link
lino
li/no-leum
lint
lin/tel
lion
lip
lipped
liq/ue-fac
liq/ue/fi
liq/ue/fy
li/ques
liquid
liq/ui-date
liqui-dation
liqui-dator
liqui-dise
liquor-ice
lis
lisp
list
listen
lis-ter
lit
lit-er
lit/era-ture
li/tharg
lithe
litho
liti
litre
little

liv
live
liveli
liver
liv-ery
liz
load
loaf
loam
loan
loath
loaves
lob
lobbed
lobby
lobe
lobu
local
lo/cal-ity
lo/cat
lo/ca-tion
lock
loco
lode
lodg
lodge
loft
lofti
loft-ily
log
logan
logi
logic
logi-cally
logi-cian
logis
logged
loi
loll
lol/li-pop
lone
long
lon-gevity
longi

look
loom
loop
loose
loos-ened
loot
lop
lopped
lor
lord
lor-gnette
los/able
lose
loser
loss
loud
loung
louse
lout
lov
love
low
lower
loyal
loy-al-ist
loy-ally
loy-alty
lu
lub
lu/bri
luck
lug
lugged
luke
lull
lum-bago
lum/ber
lumi-nation
lumi-nes-cent
lump
lunch
lung
lurch
lure

lurk
lus
lus-cious
lush
luste
luster
lust-ful
lusti
lux
luxur
luxury
lying
lynch
lyri

M

maca
ma/ca/bre
mac/ad/am
macer
machi
ma/chine
ma/chinal
ma/chin-ist
mack
macro
macu
mad
madam

ma/dame
Ma/donna
mag
maga-zin
ma-genta
magi
ma/gi-cian
magis
ma-hog-any
maid
maidens
mail
main
maj-esty
major
ma/jori
mak
make
malan
ma/laria
ma/li-cious
mal
malig
ma/linger
ma/lonic
malm-sey
malt-ase
Malt-ese
mam
man
mana
man/age
man-ag-eress
mana-gerial
manag-ing
manga
ma/neu-ver
ma/neu-vering
mangi-ness
mangle
man-gling
mango
mani
maniacs

ma/ni-cal
mani-kin
ma/nila
man/iple
ma/nip-u
manned
manu
man/ual
ma/nure
mantle
map/ping
mar
mara
ma/raud
marble
march
mari
mark
mar-ket
marks
marl
marsh
marshi
marred
Marx-ism
mas
mashe
mask
mas-ochis
mason
Ma/sonic
mas-quer
mass
mas-si
mas-sive
mas/ter
mast/head
mat
mata-dor
match
ma/te-ri-ability
ma/te-rial
ma-tern
ma/ter-nity

math
mati/nee
mating
matri
ma/tri-cu
matro
matron
matu
ma/tur-a-tive
ma/ture
ma/tu-rity
maud-lin
maul-stick
maun-der
mau/so-leum
mav-er-ick
max-i
max-il
may
meal
meali
mean
me/ander
me/an/dering
me/an/drous
measur
mea-sure
mec
me/chan
mechano
med
meddle
medi
media
me/dian
me-di-as
me/di-ate
me/dia-tion
me/dia-tor
me/dia-tor/ial
medi-cally
medi-cate
medi-cate-ment
med-icin
med-icine
me/dio-cre
me/dium
meek-ness
meet-ing
meg
mega
megalo
mei
mel
me/lior
melo-drama
melo-dramatic
melt
mem
memoir
memo-ran-dam
men
mend-able
mende
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meno
men-or
me/no/rah
mep
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merge
merging
me/rid
me/ringue
meri-tori-ous
mero-blas
merry
mes
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meso
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metal
me/tal-lurgy
metar
meteor
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meth
method
meticu
metri
metro
metrop-olis
mettle
micro
mi/cro-meter
mi/crom-etry
mi/cron
mic-tur
mid
middle
midge
might-ily
might-i-ness
mi/grant
mi/gra-tion
mi/gra-tor
mil
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mile
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milk
mill-ing
mil-lion
mill-stone
mim
miming
min
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mind
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min-eral
min-ette
mingle
min-gling
mini
min-ia
min-is
min/ium
mint-age
minte
min-uend
minute
mir
mirth
mis
misse
miss-ile
mis-sion
mist-ily
misti-ness
mistle
mit
mith
miti
mitre
mix
mo
moan-ing
mob
mobbed
mo/bil
moc-ca/sin
mock
mod
mo-dal
modi
mod-ify
modu
mod-ule
mo/hair
moist
moisture
mol
moldi
moldi-ness
mole-hill
mole-skin
molest
mo/line
molte
molly-coddle
mo/men
mo/mently
mon
mona-chal
mona-chism
money
mon/ger
mongol
mon/grel
moni-tor
moni-torial
moni-tress
monk
mon/key
monks
mono
mo/noc-racy
mo/nop-ol
mo/noto-nous
mo/not-ony
month
monu
mood-ily
moodi-ness
moon
moor
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mopped
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mora
mor/aine
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more-over
morgue
mori
morio
morn-ing
mo/rose
mor-phia
mort-gag
mort-gage
mos
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mosque
mossi-ness
most
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mother
motor
mottle
mot-toes
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moun
mount-ing
mourn
mouse
mousse
mous-tache
mouth
mov
move
mow
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mud
muddle
muffle
mug
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multi
mul-tiple
mum
mumble
munche
mun-dane
mun-ster
mur/der
murk-ily
mur-mur
mur-raine
mus
muscle
mu/seum
mush-room
musi
mu/si-cian
musing
mus-ings
musk-rat
muste
musti-ness
mutter
muttling
mutton
mutu
muzzle
muz-zling
my
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neg-lige
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Negress
Negro
Ne/groid
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neo
neo-natal
neoc-racy
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nephew
nerve
nerv-ing
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nest
nes/tle
nest-ling
Nether-lands
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nom-in
nomi-nate
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nomi-nator
nomi-nee
non
nona-ge-nar/ian
none
noodle
noon
noose
nor
nor/mal
nor-mality
north
north-erners
nos
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nosing
nota-bility
note
noth-ing
no/to-ri
no/to-riety
not-with-stand/ing
nou
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nour-ish
nov
novel
nowa-days
nox-ious
noz/zle
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nui-sance
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ny-lons
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O

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off-beat
off-cast
offend
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off-print
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off/shoot
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omi-cron
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opal
opaque
open
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oper-at-able
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opin-ion
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opos-sum
op/po-nent
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P

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pains-tak-ing
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pala-tial
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paper
pa/poose
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par-able
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par-ading
par-af-fin
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pa/rab-ola
parch-ment
par/ent-age
park
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part-ner
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pas-sen-ger
pas-sion
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patchi-ness
patent
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path
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patron
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paus-ing
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paving
pawn
pay
pea
peace
peak
peal
pearl
peas-ant
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peck
pecu
peculi-
peculiar
ped
peddle
pedi
peep-hole
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peli-can
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phys-ics
physi-other-apy
phy-sique
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pic/ca-lilli
pick
pickle
pid
pie
piece
piec-ing
pier
pierced
pierc-ing
pig
pigeon
pike
pil
pile-driver
pill-box
pi/lot
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pinch
pine-apple
pine-wood
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pioneer
pip
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pi/racy
pi/rate
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pitch
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plac-able
plac-ard
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plague
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plant-ing
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plat-form
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pleas-ant
please
pleas-ing
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poison
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policies
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poli-tician
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porter
por-tion
por-trait
portray
portu-guese
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possi-bility
pos-sibl
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post-hum
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pov-erty
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power
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prank
prayer
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pre-ci-pice
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pref-ac
pref-er
pre-ferred
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pre-lude
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pre-mier
pre-mis
prep-aration
prep-osition
pres-by-ter
pre-sen-tation
pres-er-vation
presi-den
press
pres-sure
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pretti
preva-len
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price
pricing
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priest
prig-gish
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pri-meval
primi-tiv
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prince
prin-cess
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priv
priv-acy
pri-vate
priva-teer
privi-lege
prize
pro
prob-ability
prob-abl
probing
prob-lem
proc-la-mation
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pro-cure
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prod-ding
prodi-gal
prod-igy
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prog-na-thous
prog-nos
promi-nent
prom-is
prom-on
prompt
proof
prop-er
proph
pro-pheti
prop-osition

rear
rear-guard
re/arma-ment
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re/arrang-ing
reason
re/bel
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re-bel-lion
rec
re/cal-ci-tra
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receipt
receive
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re-ceiv-ing
re-cently
re-cep
recipe
re-cipro
reck
reckon
recluse
rec-og-ni
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rec-og-niz-abl
rec-og-nize
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rec/om-mend
rec/om-pense
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rec-on-cile
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re-con-noiter
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re-coup
re/course
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rec-ti
rec-ti-fi
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red
red-breast
red-den
red-dish
red-head
red-ness
reed
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re/es-tab
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ref-eree
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ref-uge
refu-gee
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regi-men
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rely
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rel-egation
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rel-evan
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ren/der
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reno-vat
reno-va-tion
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re/or-gan
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rep/re-hen
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rep-ri-mand
rep-ro
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re/pro-duc

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re-spi
re/spon
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rep-ti
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re/pu-ting
req-ui-site
req-ui-si-tion
res-cu
re/sent
re-serv
re/ser-voir
resi
re/sid-ing
re-sign
res-ig-nation
re/sili
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resol
reso-lutely
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res-o-nance
res-onant
re-strain
re-stric

res-ur
re-surge
re/sur-gence
re/sus-ci
retch
reti-cent
ret-icle
retour
retro
retro-spect
rev-eille
rev-el
re/veled
re-ver
rev-er-en
rev-er-ent
re-vers-ible
re-vers-ing
revert
re-vis
re-vi-so
rev-o-lution
rhap
rheum
rheu-ma
rheu-matic
rhet-oric
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rhyme
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rib
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rich
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righ-teous

pros-ecut
pros-pect
pros-perity
pros-ti
pros-trat
prot-es-tant
proud-ly
prov-er
provi-den
prov-in
prow/ess
prowl
proxi
pru
pry-ing
psalm
pseud
psy
psycho
psy-cholo-gist
psy-chol/ogy
pub
pu/berty
puck
pud
pu/den
pudding
pul
pul-ley
pull
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pun
punc
punche
pup
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pure
purge
pur-ging
puri
pur-ist
purr-ing
purs-ing
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Q

quad
quad-ri
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qual-ify
quali-tat
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quar-rel
quar-relled
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quartz
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quarter-cen
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qua-tre
quaver-ing
queas-ily
queasi-ness
queen-liness
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query-ing
queru-lous
ques-tion
quet-zal
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quilt-ing
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quinary
quinate
quini-dine
quin-qua
quin-quen
quinque-par-tite
quip-ping
quip-ster
quire-wise
quit
quiv-er
quix
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quizzled
quo
quod-li-bet
quon-dam
quot-ability
quot-able
quoted

R

rab
rabble
rab-bler
rabies
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radi-ant
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radi-ation
raf-ter
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raging
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readily
readi-ness
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re/appear
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rigid
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ri-valed
road
roast
rob
robbed
robot
ro/bust
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rod
ro/dent
rodeo
rois-ter
roll
rol-lick
Roman
ro/mancer
roof
romp
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roost
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rope
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route
row
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ru/di-men
ruffle
ruin
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rum
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ru-mor
rumple
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rup
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rush
russet
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rustle
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rut-ted

S

sac
sack
sacred
sad
saddle
sadis
sa/fa-ri
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sagged
sail
saint
sal
sala-man
sale
sales
salien
sal-lied
salmon
sa-loon
salt-cellar
salted
salt-ing
salti-ness
salu-tation
salv-able
sam
same-ness
sample
san
sana
sanc
sand
san-dal
sani
sap
sapien
sapphir
sar
sat
sa/tani
satchel
satia-bility
satis-fac-
satis-fy
satu
sat-ur-day
sa-tyric
sauce
saun-ter
sav/age
sav/ior
sa-vori-ness
sa/vor-ous
saw
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saxo-phone
say/ing
scab
scai
scalde
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scalped
scam-per
scamp-ish
scan
scanned
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scanti-ness
scape
scapu
scar-city
scarf
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scar-let
scar-ring
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scath-ing
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sched
schema
sche-matic
schem-ing
schol-ar
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scoop-ful
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scor-ing
scorn
scoun-drel
scout
scowl-ingly
scrab-bling
scrag-gi-ness
scram-bler
scram-bling
scrap
scrap-ping
scream-ing
screw-driver
scrib
scribble
scroung-ing
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sculpt-ing
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scut-tling
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sear-ing
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se-curi-ties
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seda-tive
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seek-ers
see-ing
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see-saw
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seller
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sen
sena-tor
send-ing
se/nile
senior
sensed
sens-ing
sep
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serial
se/ri-ous
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settle
sev
sev-enty
se/vere
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shade
shad-ow
shak
shake
shal
sham
shamble
shame
share
sharp
sheep
shel
shell-fish
shell-proof
shep-herd
shift
shil-ling
ship
shiv-ered
shoot-ing
shop
shop-ped
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show
shut-ting
sick
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signe
sign-post
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silent
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sim
simi-lar
simple
simu
sim-ul-taneous
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singu
sink
sinu
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siphon
sir
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skel
sketch
skid
skil
sky
slack
slan
slaugh-ter
sleep
sleepi-ness
slen-der
slip
slip-ped
slith-ered
slower
slum
smil-ing
smok
smoke
snap
snapped
snarl
snow
soberly
so/bri-ety
social
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sol
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sol-dier
sole-noid
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soli-da
soli-tar
soli-taire
solu-bility
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somer-sault
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song
sooner
soph
sop-ping
sort
sorter
sound
south
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spark
spas
speaker
spec
speci
spe-cial
specu
speed
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spin
spine-less
spir
spiri-tual
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spon
spong-ing
spor
sport
sports
spot
spring
stag
stage
stain
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stale
stalk
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stan
stand
stan-dard
star
starch
start-ing
startled
start-ling
starv-ing
stat
state
states
station
statu
steam
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ste-nog-ra-pher
ster
stereo
stern
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stig
still-born
still-ness
stimu

stip
stipu
stir
stock
stop
stopped
straight
strangely
stranger
stra-tegi
stricken
stri-dent
strip
stripped
struc
strug-gling
stub
stumbling
stun-ning
sub
suc
suck
sud/den
suit
sul
sulk
sum
sump
sun
sup
super
supe-rior
su-preme
sur
sure-ness
sus
sweater
swim-ming
syl
symp-to
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synchro
synchron
syr
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T

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tab/let
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tailor
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tel-egra
tell
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tem-per
tem-pera
tempt
temp-tation
tempt-ress
ten
tended
tense
tenth
tepee
tepid
ter
termed
ter-min
termor
terse
tes
tested
testily
tet
tether
teth-ered
tetra
tex
text-book
thank
thanks
thatch
thaw
the
theatre
theft
theme
them-selves
thence
theo-ret-ical
theory
ther
there
thermo-bound
thick
thief
thiev
thin
think
thin-ned
thir
thir-ti
this-tle
tho
thorn
thorough
thou
thought
thread
threat
three
thresh
thresh-old
threw
thrift
thrill
throb
throbbed
throm
through
throw
thrust
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thumb
thump
thun
Thrus-
thy
thyme
thy-roid
tick
ticket
tickled
tide
tidi-ness
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tight
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till

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tim/ber
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tinc
tinge
tingle
tingling
tink-ling
tinned
tip
tipped
tipple
tit-il
titu
toast
tobac
tobag
toc
toddle
tod-dler
tog
together
toggle
toilet
toi-letry
tol
toll
tom
tomorrow
ton
tonal
tone
tongue
tongu-ing
to/night
ton-nage
tool
top
topi
topped
topple
tor
torch
tor-so
tor-tur
total
to/tal-ing
totali
total-is
totalled
touch
touchi
tough
tour
tow
toward
towel
toweled
tower
town
towns
trac
trace
tracing
track
tra-dition
tra-ge-dian
tragi
trail
train
trai-tor
tram
tramp
trample
tran
trance
trans-act
trans-action
trans-atlantic
trans-ceiver
trans-duc
trans-fer
trans-ferred
trans-figur
trans-fix
trans-form
trans-fus
trans-fusion
trans-gress
trans-gression
tran-sition
trans-lat
trans-lation
trans-luscen
trans-mission
trans-mit
trans-paren
tran-spire
trans-plan
trans-port
trans-pos
trans-po-sition
trans-ver
trans-verser
trans-vert
trap
trapped
trash
trau-matic
trav
travel
trav-elled
tra-vers
trawl
treach
tread
trea-son
treat
trebl
tree
trek
trekked
trem
tremble
tremen
tremo
tremu
tri
trial
tri-angu
tribes
tribal
trick
tricki
trickle
trifle
trif-ling
trig
trill
trimly
trip
tri/pod
tripped
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trod
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trol
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troop
trop
tro-phies
trot-ting
troub
trouble
trough
trounce
troupe
trou-ser
trowel
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truck
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trudg
trudge
trum
trumped
trun
trunc
trun-cheon
trundle
trunk
truss
trust
truth
try
tu
tubbed
tubing
tuck
Tues-day
tuft
tug
tugged
tum
tum/ble
tu/mult
tun
tune
tung
tuning
tur
turn
turtle
tusk
tuss
tussle
twist
twitch
two
ty
tym
type
typi
tyr
ty/rant
tyre

U

ubiq
ugli-ness
uku-lele
ul
ul/cer
ultra
ulu
um
um/bel
um/bra-geous
un
un/ac
un/achiev
una-nimity
un/ap
un/ap-preci
un/ar
un/armed
un/as
un/ashamed
un/asked
un/at
un/aton-abl
un/attended
un/bal
un/be
un/bear
un/beaten
un/ben
un/bend
un/cer
uncle
un/com
un/comfort
un/con
un/conquered
un/cor
unc/tu
un/de
un/deci-mal
un/dedi-cated
un/demo-cratic
under
un/dis
un/du
un/due
un/duly
un/ec-on-omic
un/em
un/employ
un/en
un/ex
ungu
un/guen
un/gui
un/guic
uni
un/identi
un/idi-o-matic
un-im
un/ima-gin-ative
un/in
un-in-tel
union
unique
un/issued
unit-age
unite
uni-ver
univo-cal
un/ob
un/pre
un/preju-diced
un/pro
un/profit-able
un/prom-is-ing
un/pros-per-ous
un/ques
un/re
un/read
un/reason
un/rec-og-nis
un/rep-re
un/rest
un-sus
un-sym
up
up/per
ur
ura
urae-mia
ural-ite
ura/nic
ura-nology
ura-nium
urg/ing
uri
uro
ur/ti
us
usable
usance
use
usher
ush-erette
usi
usu
usual
usuri-ous
usurp
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uter
util
utili-tarian
utricu
ut-ter
uvu

V

va/cate
va/cat-ing
va/ca-tion
vac-ci
vac-cine
vacil-late
va/cil-lation
va/cu-ity
vac-u-ous
vac-uum
vaga-bond
vagin
va/gina
vagran
vague
vain
val
va/lance
val-edic
valen
val-en-tine
valet
val-ian
val-iant
vali-date
va/lid-ity
va/lise
val/ley
val-or
valu
value
valu-ing
valve
val-vu
vam-pir
van
va/pid-ity
va/pidly
vari
vari-cose
var-iety
vapor
var/let
var-nish
vas
vassal
vast
vat
Vat-ican
vault
ve
vec/tor
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veg-etar-ian-ism
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veil
vein
vel
ve/lour
ve/lum
ven
ve/nal-ity
vend
ven-dor
ve/neer
ven-er
ven-er-ation
vene-real
venge-ful
ven-ison
venom
ven-om-ous
vent
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ven-tral
ven-tricle
ven-tril
ven-ture
ver
ver/bal

verge
verg-ing
veri-fi
ver-min
ver-nacu-lar
ver/sa
verse
ver-si
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ver-ti-cal
verve
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vessel
vest
vet-eran
vet-er-in
vetch
vex
vi
vi-car
vic-ar-age
vi-cari
vice
vicin-ity
vicious
vicissi-tud
vic/tim
vic-tori
vic-tory
victual
viet
view
vig
vig/il
vignette
vig-or-ous
vil
vile
vili-fi
vili-fier
vil-ify
villa
vil-lage
vil-lain
vin-di
vine
vin-egar
vine-yard
vin-tage
vint-ner
vio
vio-lent
vi-per
vir-gin
vir-ginity
vir-il
vir-tu
vir-tual
vir-tue
viru
vis
vis-age
vis-count
visi-bil
vision
visit
visi-tor
vi/su-al-iza-tion
vis/ual
visu-al-iz
visu-ally
vit
vi-tality
vit-amin
vit-reous
vit-ri-fi-cation
vit-rifiy
vit-ri-olic
vi/tu-per-ate
viva-cious
vivac-ity
viv-idly
viv-id-ness
vivi-sect
vivi-sec-tion
vivi-sec-tor
vixen
vix-en-ish
vi-zier
vo/cab
vocal
vo/cal-is
vo/ca-tion
vo-cifer
vogue
voic
voice
void
vol
vol-atile
vol-canic
vol-ca-nize
vol-cano
vo/li-tion
vol/ley
volt
vol-ubl
vol-ume
vol-umin
vol-un
vol-un-tarily
vo/lup
vo/lup-tuous
vomit
voo-doo
vor
vo/ra-cious
vo/rac-ity
vor/tex
vote
vouch
vowed
vowel
voy-ag
vul
vul-gar-is
vul-gar-ity
vul-garly
vul-ner
vul-ture

W

wad
waddle
wading
waft-age
wag
wager
wagged
waggle
waging
wagon-ette
wail-ing
wain
waist
wait
wake
waken-ing
wak-ened
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wan-der
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wan/ton
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warble
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war-den
war-der
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wari-ness
warme
warmly
warn-ing
warp-age
warped
warp-ing
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wast-age
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wast-ing
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waxi-ness
way
weak
weapon
wear-able
weari
wear-ing
weath-er
weav-ing
web-bing
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wedge
wedg-ing
week
weep-ing
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well-spring
welted
wel/ter
weren
Wesley-an
west
wet-ness
wet-ting
whale
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wheel
when
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where-ever
whet
whether
which
whim

whip
whipped
whirl
whir-ring
whis
whisked
whistle
whit
white
whit-en-ing
whither
whit-ing
whittle
whiz-zing
who-ever
whole
whom-so-ever
whoop-ing
who-so-ever
whop
wick
widen-ing
wide-spread
widow
wield-able
wife-less
wig
wigged
wiggle
wiggly
wil
wild
wil-der-ness
willed
will-ing-ness
win
winc-ing
wind
win-dy
windi-ness
wind-ing
window
wine
wing
wining
wink
win-ter
wire
wiri-ness
wir-ing
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wise
wish
wist
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witch
with
wiz
wob
wobble
wobbly
woe
wolf
wolfish
wol-ver-ine
woman
women
won
won-der
wonted
wood
woodi-ness
woods-man
wool
word
wordi-ness
words-worth
work
workers
work-man
world
worm
wor-ri
worry-ing
wors-en-ing
wor-ship
wor-shipped
worth
worth-ily
worthi-ness
wrap
wrapped
wrath-ful
wreck-age
wres-tler
wres-tling
wrig-gler
wrig-gling
wring-ing
wrink-ling
wrist
writ-ten
wrong
wry

X

xan
xe/an
xenia
xeno
xero
xero-der
xe/ro-graphic
xeroph
xe/rosis
xe-rotic
xipho
xiph-oid
xy
xyli-dine
xylo
xy/lo-grapher
xy/log-raphy
xy/loid
xy/loma
xy/lonic
xy/lopha
xy-lophi
xy/lose
xy/loto

Y

yacht-ing
yachts-man
yard
yar-mulke
yaw-ing
yawn-ing
year
yearned
yeasti-ness
yel/low
yeo-man
yes-ter-day
yield
yo/del
yoke
yo/kel
yon/der
young
young-ish
your
youth
yp
yper-ite
yt
yt/ter
yt/tro

Z

zealous
ze/bra
ze/brine
ze/broid
ze-nith
ze/nith/al
zeo
zephyr
zero
zest
zig-zag
zig-zagged
zinc
zinco
zip

zipped
zir
zither
zith-er-ist
zo
zom-bie
zoo-log-ical
zo/olo-gist
zoom
zoomed

Glossary

A

AA's. An abbreviation of Author's Alterations.

ABC Inventory Control. A system that divides inventory into three dollar volume classifications, A.B.C. where A is the most active, and C the least.

Accent. A mark used in typesetting to indicate a specific sound value, stress, or pitch, or to indicate that an ordinarily mute vowel should be pronounced. A diacritical mark. The accent can be positioned above, below or through the alphabetic character.

Accent	Name	Example
´	Acute	é
`	Grave	è
ˆ	Circumflex	ê, ô
˜	Tilde	ñ
¯	Macron	ā
˘	Breve	ĕ
¨	Diaeresis or dieresis (also umlaut)	ë, ö, ü
¸	Cedilla	ç

Table 17. Accents

Accent, Floating (Piece). The accent sign is positioned on the matrix so that if exposed on its own it would be aligned with the vertical register line of a character. However, the logic of the typesetter or computer calculates one half of the width of the character to be accented and assigns that much horizontal displacement (escapement) to the accent to center the accent on the character. Thus, the escapement before the accent is exposed varies according to the width of the character it is used with. By assigning horizontal displacement 'offset' values, one accent sign can be used with a number of typestyles; e.g., Roman and Italic to produce an aesthetically pleasing appearance. For aesthetic reasons, if the division of the character width by two leaves a remainder, the next highest whole number is used as the left side escapement value for the accent.

Accent, Pre-positioned. The accent sign is positioned on the matrix so that when exposed it is offset a predetermined amount from the vertical register line of a character. Although the accent sign has no width assigned to it, the displacement of the image allows it to be used with characters of a similar width and design without moving the escapement mechanism. The sequence of exposure is normally the character followed by the accent on machines setting text from left to right, and the accent followed by the character on machines setting from right to left.

Normally, Roman accents cannot be used with italic characters of the same weight because of positional difference. Similarly, Roman accents cannot be used with Bold Characters because of design (weight) differences.

Accrual Basis. An accounting method in which income is recorded in the period in which the sales are made while expenses are recorded as they occur.

ACK. The abbreviation for acknowledge character. A communication control character transmitted by a receiver as an affirmative or acceptance response to a sender. An acknowledge character may be used as an accuracy control character.

Account Mark (a/c). Symbol used principally in commercial work.

Acute. An accent (´) which stresses the vowel over which it is positioned.

Ad, Ads. An abbreviation of the word advertisement(s).

Adder. (1) A device whose output produces representation of the sum of the quantities represented by its inputs. (2) See half-adder.

Address. (1) An identification; as represented by a name, label, or number, for a register location within storage or any other data source or destination such as the location of a station in a communication network. (2) Loosely, any part of an instruction that specifies the location or position of an operand for the instruction.

Address constant. Synonymous with base address.

Address format. (1) The arrangement of the address parts of an instruction. The expression 'plus-one' is frequently used to indicate that one of the addresses specifies the location of the next instruction to be executed, such as one-plus-one, two-plus-one, etc. (2) The arrangement of the parts of a single address such as those required for identifying channel, module, track, etc. with a disk system.

Address part. A portion of an instruction word that specifies the address of an operand, instruction or result. Contrast with instruction address.

Address register. A register in which an address can be stored.

Add thin space. Originally, a procedure used to achieve justification on a linecaster. Thin spaces are added to some or all of the spacebands within a line. To specify add thin in TTS code, the code sequence (3,0) is used. This is the product of a thin (0) and a spaceband code (3). The add thin space code (3,0) in computer typesetting can be assigned to represent a command or be used as a flag code.

Advanced Sprocket Feed (Hole). Refers to the relative position of the sprocket hole to data holes in punched paper tape. With a 6-level tape it indicates tape direction. The sprocket hole is off-center from the data holes and is in line with the leading edge of the larger data holes. It is used predominantly for the printing industry in 6-level TTS although some 7- and 8-level advance sprocket systems do exist.

Additional Leading. Space inserted between lines in addition to normal interline (end of line) leading. It is used to make the text aesthetically more pleasing, more readable or fit a defined area. It will occur, among other places, at the end of a paragraph between a heading and text, etc.

Agate. Type smaller than 6 point. Approximately 5½ point. Fourteen lines of agate make one inch of matter for newspaper advertising.

Algol (Algorithmic Oriented Language). A language principle used to express computer programs by algorithms.

Algorithm. A prescribed set of clearly-defined rules or processes for the solution of a problem in a definite number of steps.

Algorithmic language. A language designed for expressing algorithms.

Aligned, Base. Characters which are positioned, irrespective of design proportions, so that the base of the characters, excluding descenders and any adjustments for optical effect, have a common alignment. On a phototypesetter this also allows typestyles of differing sizes to be mixed within a line while still maintaining base alignment.

Aligned, Non. The characters are positioned or magnified in such a way that the Base Line varies. In hot-metal composition the base line of certain typefaces in a given point size will vary from the norm for design reasons. Consequently, if mixed with characters which have the normal alignment, the two typestyles will not align. In photocomposition where a zoom lens system of magnification is used, the reference line is drawn through the center of the characters. Therefore, when the characters are magnified or reduced the expansion and contraction takes place above and below the reference line, constantly changing the location of the baseline. Most phototypesetting systems employ automatic (correction) procedures for correcting this condition. The correction procedures are not perfect and usually there are some limitations in mixing.

Alignment (Alinement). The position of letters within a line which has an even appearance when looked at horizontally.

Alive. See Live Matter.

All In. All copy and proofs are available.

Alterations. See Author's Alterations.

Alphabet. (1) An ordered set of all the letters and associated marks used in a language or work. (2) An ordered set of letters used in a code language; e.g., the Morse code alphabet, the 128 characters of the USASCII alphabet.

Alphabet Length. The measurement in points of the lower case alphabet of a particular style and size.

Alphabetic code. A code whose code set consists of letters and associated special characters.

Alphabetic String. A character string consisting of letters from the same alphabet.

Alphanumeric (Alphameric). Contraction of alphabetic and numeric. Refers to code representations of information in machine readable form, consisting mainly of alphabetic (letters) and numeric (numerals) data with additional symbols and punctuation marks.

Ampersand. (Short and, &). The name of the sign used for 'and' derived from Latin "et".

Analog Computer. A computer that produces continuous output based upon a continuous measured input. Not generally used in composition systems.

Appendix. Matter added to the text after it has been completed; it may include information omitted from the body of the book or it may elaborate upon or clarify the text.

Argument. An independent variable; e.g., in looking up a quantity from a table, the number, or any of the numbers, that identifies the location of the desired value.

Arithmetic Check. Synonymous with mathematical check.

Arithmetic Shift. (1) A shift that does not change the sign position. (2) A shift that is equivalent to the multiplication of a number by a positive or negative integral power of the radix.

Arithmetic Unit. The unit of a computing system that contains the circuits that specifically perform the arithmetic operations.

Ascender. The portion of a lowercase character above the x or z height. b, d, h, l, etc. (See x height, Descender, Type Nomenclature)

ASCII (USASCII). Acronym for the code standard 'American Standard Code for Information Interchange'. It is a 7-bit code, excluding parity, which provides for 128 discrete characters.

Assemble. To produce a machine language program from a symbolic language program by substituting absolute operation codes for symbolic operation codes and absolute or relocatable addresses for symbolic addresses.

Assembler. A program that assembles.

Associative Storage. A storage device in which storage locations are specifically identified by their contents, not by names or positions. Synonymous with content-addressed storage.

Asterisk (Star). Used in text and footnotes as the first point of reference or as a reference mark or indication of the omission of letters or words (ellipses).

Author. The writer of book(s) or articles(s); frequently the term refers to a writer of copy for matter to be composed, whether he be advertiser, editor or journalist: a loose term commonly used by printers.

Author's Alterations (AA, Corrections). Alterations from the original copy on galley or page proofs for which the printer makes an additional charge.

Author's Corrections. See Author's Alterations.

Author's Proof. (1) A proof that is to be shown to an author. (2) Galleys or pages returned by author O.K. or O.K. with corrections.

Auto Leaders. See Leaders.

Automation. (1) The implementation of several processes by automatic means. (2) The theory, art, or technique of establishing a more automatic process. (3) The investigation, design, development and application of ways of rendering processes automatic or self-controlling. (4) The conversion of a procedure, a process, or equipment to an automatic operation .

B

Background Processing. The automatic execution of lower-priority computer programs as and when higher-priority programs are not using the system resources. Contrast with foreground processing.

Backslant. The design or reproduction of characters which has the angle of stress or slant from the top left to the bottom right. Opposite of italic. Often Roman characters are reproduced through a distortion lens to achieve the effect.

Backspace. To move back the reading or display position according to a prescribed manner.

Backspace Character. A format effector that causes the location of the printing or display position to be moved or positioned backward one printing or display space. Abbreviated BS.

Backup. Auxiliary equipment and procedures that are utilized in the event of malfunction of the main system. Means to prevent malfunction of the main system. Backup may include having duplicate equipment.

Bad Break. In make-up, the placing of a breakline or widow as the first line of a page. A break in text which is unacceptable to the established rules. Also incorrect word-division.

Bad Copy. Manuscript that is indistinct, illegible, improperly edited or otherwise unsatisfactory.

Bad Letter. A letter that does not print or reproduce fully or clearly.

Balance. The appropriate placement of the various units of composition, illustration and ornamentation so that the appearance of the whole does not look disproportionate, but has an 'even' color.

Band. (1) A number of circular recording tracks on a storage device such as a drum or disk. (2) In communications, the frequency spectrum between two defined limits of the spectrum.

Base. (1) A reference value. (2) A number that is multiplied by itself as many times as required by an exponent. (3) Synonymous with radix.

Base address. A given address from which an absolute address is produced by combination with a relative address. Synonymous with address constant.

Base Line. The horizontal reference line from which the location of characters and signs is calculated. Normally characters without descenders are positioned on the base line ('sit on the base line'). It should be noted that to achieve the desired optical alignment certain characters (e.g., *c e o s*) will be positioned slightly below the baseline.

Base Line Deflection (Jump). The ability to command the typesetter to set a character in a position different from its 'normal' vertical position. This feature enables one design of character or sign stored in the typesetter to be set in a number of locations with respect to the base line. For example; an inferior design character located in the inferior position on the matrix can be deflected by the typesetter to the superior position. This means that only one character design need be stored in the typesetter for two or more characters 'set positions' on output.

Batch Processing. (1) Pertaining to the technique of executing a set of computer programs so that each is completed before the next program of the set is started. (2) Loosely, the execution of computer programs serially.

Baud. A unit of signalling speed equal to the number of discrete conditions or signal events generated per second, i.e., one baud equals one-half dot cycle per second in Morse code, one bit per second in a train of binary signals, and one 3-bit value per second in a string of signals each of which can assume one of 8 different states.

BCD. Acronym for binary-coded decimal notation.

Beginning of Tape Marker. An indicator on a magnetic tape used to indicate the beginning of the permissible recording area, e.g., a photo-reflective strip, a transparent section of tape.

BEL. An abbreviation of bell character.

Bell Character. A communication control character intended for use when there is a need to call for the operator; it may activate alarm or other attention devices. Abbreviated BEL.

Bevel. See Type Nomenclature.

Binary. (1) Pertaining to the numeration system with a radix or base of two. (2) Pertaining to a characteristic or property of selection, choice or condition in which there are two possibilities.

Binary-coded Decimal Notation. A positional notation in which the individual decimal digits expressing a number in decimal notation are each expressed by a binary numeral; e.g., the number twenty-three is represented by 0010, 0011 in the 8-4-2-1 type of binary-coded decimal notation and by 10111 in binary notation. Synonymous with BCD.

Binary Digit. (1) In binary notation, either of the characters, 0 or 1. Abbreviated reference is bit.

Binary Numeral. A binary representation of a number; e.g., decimal six (6) in binary is '110' and is the binary numeral and a 'VI' is the equivalent Roman numeral.

Binary Search. A dichotomizing search in which the number of items of the set is divided into two equal parts at each stage of the process. Appropriate adjustments are usually made for dividing an odd number of items.

BIT (Binary digit). Binary notation capable of describing one of two conditions; positive or negative, presence or absence, either 1 or 0.

Bit String. A string of binary digits in which each bit position is considered as an independent unit.

Black Letter. See Type Nomenclature.

Blank. A part of a medium in which no characters or codes are recorded.

Blank Character. Synonymous with space character.

Blind Keyboard. See Keyboard. A keyboard which produces code elements for key depressions which are not conveniently read by the operator.

Block. A group of consecutive bytes, words or records of convenient size, transferred as one section for input, processing, or output. (1) A set of things, such as words, characters, or digits handled as a unit or element. (2) A collection of contiguous records recorded as a unit. Blocks are separated by interblock gaps or spaces and each block may contain one or more records. (3) A group of bits, ordinary digits, transmitted as a unit over which an encoding procedure is generally applied for error or parity control purpose. (4) A group of contiguous characters recorded as a unit. Blocks are separated by interblock gaps or spaces and each block may contain one or more records.

Block Cancel Character. A cancel character used to indicate that the preceding portion of the block is to be ignored.

Block Diagram. A diagram of a system, instrument or computer in which the principal parts are represented by suitably associated geometrical figures to show the basic functions and the functional relationship between the parts. Contrast with flowchart.

Block Gap. An area or space on a data medium used to indicate the end of a block or record.

Block Length. A number of bytes or words which form a block. The block length can variably be fixed according to the system or conditions applying.

Block Transfer. The process of transferring one or more blocks of data when the data is organized in blocks.

Body Type. A general term used by printers when referring to the text which constitutes the bulk of the material set.

Bold Face. A design with a heavier appearance than Roman but containing similar design characteristics. Used for emphasis and display.

Book and Job Printer. A printer who prints principally books or commercial jobs.

Book-Work. The production of books, particularly the composition of books.

Bootstrap. A technique or device designed to bring itself into a desired state by means of its own action, e.g., a machine routine whose first few instructions are sufficient to bring the rest of the routine into the computer from an input device. Contrast with initial program loader (IPL).

Boxed Head. A heading set within a border, usually encompassed by rules.

Box In. To enclose or encompass matter with a border of rules.

Brace. The character used to embrace or connect lines, particularly in mathematics.

Break in Copy. A term meaning that there is a hiatus in the copy or a portion is mislaid or has to be supplied.

Break-Line. A short line, particularly when at the end of a paragraph.

Breve. An accent-mark (˘) used to indicate the short sound of the vowel with which it is used.

Butted Slugs. A term used to describe matter too wide to set in one line. Matter is set on two slugs, these being placed end to end with no intervening space, butted together to form one continuous line.

Byte. The term for a string of bits in parallel recording of data. A byte is the smallest addressable unit of storage. It is usually eight bits representing a text character that is usually shorter than a computer word.

C

Cancel Character. An accuracy control character used to indicate that the data with which it is associated is in error and is to be ignored. Abbreviated CAN.

Cap. Abbreviation of the word Capital. Refers to the capital or upper case letters in a font.

Capital. One of the larger series of letters of any style, of a form in contrast with lower case; as "R" in Ruth.

Caption (Legend). The explanatory comment accompanying an illustration or diagram separate from the text.

Card Column. A single line of punch positions running parallel to the short edge of the normal 3¼ by 7⅜ inch punched card.

Carriage Control Tape. A tape that contains line feed control data for use by a printing device.

Carriage Return. The sequence that prepares for the next character to be printed or displayed at the specified first position on the same line usually used with a line feed.

Carriage Return Character. A format effector that causes the location of the printing or display position to be moved to the specified first space on the same printing or display line. Abbreviated CR.

Carry Forward. The instruction to transfer text to the next column or page.

Cash Flow. The flow and outflow of cash. Accounting on an accrual basis requires this information since cash flow for a period is not the same as net income for that period.

Casting-Off. The process of calculating the space required to print a defined amount of copy in a specified font.

Catch Word. A word placed at the end of a block of text to indicate the first word of the next block or text following.

Cathode Ray Storage. An electrostatic storage device that utilizes a cathode ray beam to access the data.

Cathode Ray Tube Display. An electronic data processing term for VDT (Visual Display Terminal). (1) A device that presents data in a visual form by means of controlled electron beams. Abbreviated CRT. (2) The data display device produced by the components as in (1). Abbreviated CRT display.

Cardinal Number. The normal sequence of numbers, as one, two, three, four, etc., contrasting with the ordinal numbers, as first, second, third, fourth, etc. In the cardinal numbers, the presentation is thousand, million, billion, etc. The ordinals are thousandth, millionth, billionth, etc.

Cedilla. An accent-mark (¸) positioned under the letter c to denote an s sound, as façade.

Cent Mark. The character “c” used as an abbreviation of cents.

Center Accent. See Accent.

Central Processing Unit. A unit or section of a computer that includes the circuits controlling the interpretation and execution of instructions. Synonymous with main frame. Loosely, a term for computer. Abbreviated CPU.

Chad. The material removed when a hole is punched in paper tape.

Chain Code. An arrangement in a cyclic sequence of some or all of the possible different n-bit words in which adjacent words are related so that each end is derivable from its neighbor by displacing the bits one digit position to the left, or right, dropping the leading bit and inserting a bit at the end. The value of the inserted bit needs only to meet the requirement that a word must not recur before the cycle is complete; e.g., 000 001 010 101 011 111 110 100 000. . .

Chain Printer. A printer which has the type slugs carried by the links of a revolving chain.

Channel. (1) A path along which signals are sent, e.g., data channel, output channel. (2) The portion of a storage medium that can be accessible to a given reading or writing station; e.g., track band. (3) In communication, a means of one direction transmission. Several channels, may share common equipment; e.g., in frequency multiplexing carrier systems, each channel uses a particular frequency band that is reserved for it. Contrast with circuit.

Character. A graphic symbol, letter, numeral or punctuation mark that is used as part of the organization, control, or representation of data. A character is often in the form of a spatial arrangement of adjacent or connected strokes.

Character Complement. See Character Set.

Character Count. In fitting a portion of copy to a defined area the number of characters and spaces in the text are calculated. Normally the number of characters and spaces in the average line multiplied by the number of lines in the copy is used for calculation.

Character Grid. See Matrix.

Character Recognition. The identification of graphic, phonic, or other characters by automatic means. See Optical Character Recognition.

Character Set. An ordered set of unique representations called characters; e.g., the 26 letters of the English Alphabet, 0 and 1 of the Boolean alphabet, the set of signals in the Morse code alphabet, the 128 characters of the USASCII alphabet.

Character Set. (Complement). Each machine or system which reproduces characters has a selection which is referred to as the character set. This character set typically contains alphabetic lower case and any character germane to the material or language being set (i.e., accents, reference marks, etc.). The terms Character Set and Font are synonymous.

Character Spacing Reference Line. In optical character recognition, a vertical line that is used to evaluate the horizontal spacing of characters. It can be a line that equally divides the distance between the sides of a character boundary or that coincides with the centerline of a vertical stroke.

Characters-per-pica. The average number of characters in a given font that will fit within a given pica measure.

Character String. A string which consists solely of characters.

Character Subset. A selection of characters from a character set comprising all characters which have a specified common feature. For example, in the definition of character set, the digits 0 to 9 constitute a character subset.

Check. A means for determining accuracy.

Check bit. A binary check digit, synonymous with a parity bit.

Check Character. A character which is used for the purpose of performing a check.

Check Digit. A digit which is used for the purpose of performing a check.

Checkpoint. A place in a routine where a check is performed or a recording of data for restart purposes is carried out.

Cicero. The unit of printing measurement predominant on the continent of Europe. Twelve didot points are equal to 0.1776-inch.

Circuit. In communications, a means of two-way communication between two points, comprising associated ‘go’ and ‘return’ channels. Contrast with channel.

Circulating Register. A shift register in which data moved out of one end of the register is reentered into the other end as in a closed loop.

Circulating Storage. Dynamic storage using a closed loop. Synonymous with cyclic storage.

Circumflex. Accent (^), denoting the long sound of a vowel, as in the word rôle.

Clean Proof. A proof containing virtually no corrections.

Clock. (1) A device that generates periodic signals that are used for synchronization. (2) A device that can measure and indicate time. (3) A register whose content changes at regular intervals in such a way that it measures time.

Clock Pulse. A synchronization signal generated by a clock.

Clock Track. A track on which a pattern of signals has been recorded to generate a time reference.

Close Matter. Type matter set with few or no points of additional space.

Close Punctuation. An exaggerated use of commas or other punctuation marks, as in legal work.

Close Quotes. A pair of apostrophes positioned at the end of a quotation.

Closed Subroutine. A subroutine that can be stored at one place and can be connected to a routine by linkages at one or more locations. Contrast with open subroutines.

Close Spacing. Type with as little space as possible between the words.

Close Up. Bring together by taking out space.

Code. A unique combination of binary digits defining a character or function.

Code Extension Character. A control character used to indicate that one or more of the succeeding code values are to be interpreted according to a different-from-normal code. See Supershift, Flag Code and Escape Character.

Code Set. A finite and complete set of representations defined by a code. Synonymous with code.

Code Value. One element of a code set, e.g., the eight-binary code value for the delete character. Synonymous with code.

Cold Type. Type that is set on any photographic process. Contrast with hot type. See Phototypesetting.

Collating. Comparing a proof with copy as distinguished from reading with a copyholder. Sometimes called horsing. Examining the signatures or sections of a book for proper arrangement.

Colophon. An inscription (trademark) placed usually at the end of a book with information relating to the production of the book.

Column Rule. The rule used to separate the columns of text in printed matter.

Command (Command Code). A code which determines or commands a function as distinct from a text or data code. Commands instruct the device (typesetters, computer) what typeface, point size, leading, etc. is required.

Command. (1) A control signal or instruction. (2) Loosely, an instruction in machine language. (3) Loosely, a mathematical or logic operator.

Command Language. A source language consisting principally of procedural operators, each capable of invoking a function to be executed.

Commercial Signs. Term applies to trade symbols and marks which are set with text or supplied as art work.

Common Field. A field that can be accessed by two or more independent routines.

Communication Control Character. A control character intended to control or to facilitate transmission of data over communication networks.

Communication Link. The physical means of connecting two locations for the purpose of transmitting and receiving information.

Compile. The act of preparing or producing a machine language program from a computer program written in another programming language by making use of the overall logic structure of the program; generating more than one machine instruction for each symbolic statement, or both, as well as performing the function of an assembler.

Compiler. A program that can compile.

Complement. A number that can be derived from a specified number by subtracting it from a specified number. For example, in radix notation, the specified number may be a given power of radix or one less than a given power of radix. The negative of a number is often represented by its complement.

Compose. The language and spatial make up of text in proper order and form.

Composition. The setting of type matter or the type matter set.

Compound Word. A word consisting of components that are words; e.g., showtime.

Computer. (1) A data processor that can perform sustantial computation, including arithmetic or logic operations, without intervention by an operator during the process. (2) A device capable of solving a process, problem or problems by accepting data, performing prescribed operations on the data, and supplying the results of these operations. Various types of computers include calculators, digital computers, and analog computers.

Computer Code. A machine code for a specified computer.

Computer Instruction. A machine instruction for a specified computer.

Computer Network. A system consisting of two or more interconnected computers.

Computer Program. A series of instructions or statements in a form acceptable to a computer and prepared in order to achieve a defined result.

Computer Word. A sequence of bits or characters treated as a unit or element, and capable of being stored in one computer location. Synonymous with machine word.

Condensed Type. A design of type style in which the height of the characters is greater in proportion to their width than in a normal typestyle.

Contraction. The shortening of a word or words by omitting letters other than the first and last.

Control Tape. A tape which contains control information as distinct from a text or data tape; i.e., typographic parameters, formats, character widths.

Copy (Manuscript). The raw material, either hand written or typewritten, for typesetting.

Copy, Reprint. A previously printed job submitted as copy, sometimes with alterations, for printing.

Copy. To reproduce data in a new or different location or other destination, leaving the source data unchanged; the physical form of the result may differ from that of the source. For example; to copy a deck of cards onto a magnetic tape. Contrast with duplicate.

Copyfitting. The procedure for calculating the space which will be occupied by a defined amount of copy in a defined font when typeset.

Core. See Magnetic Core. A computer storage device.

Correct. To mark errors in a proof or to remedy faults in type.

Correction. Loosely, the mark of a fault in a proof. The change made in the type to conform with the mark made in the proof.

CPU. The abbreviation for Central Processing Unit.

CR. The abbreviation for carriage return character.

Cross Head. A heading across-completing one or more columns.

Cross Reference. A reference which draws attention to another reference in the same work.

CRT. Cathode Ray Tube. An electronic tube used for generating displays. A home TV utilizes a CRT.

CRT Display. See Cathode Ray Tube Display.

Cycle. (1) An interval of space or time in which one set of events is completed. (2) A set of operations that is repeated regularly in the same sequence. The operations can be subject to variations on each repetition.

Cyclic Storage. Dynamic storage utilizing a closed loop in which the data is constantly moving, e.g., a shift register used for storage by connecting end to beginning.

D

Dagger (Obelisk)†. The second footnote reference mark.

Dash. See Rule. A typographical character or sign. The terms Dash and Rule have different meanings to different people and companies. The ensuing explanation is a *guide* and should not be taken as a definitive statement. If in doubt, check with the relevant supplier or user.

Dashes can be classified under four headings:

(1) Weight
(2) Design
(3) Width of image and width of space allocated
(4) Vertical position

Weight. This is proportioned to accord with the design of the characters with which the dash will be used.

Design. Normally a dash is a narrow, square-cornered, oblong character. However, dashes are produced which are rhomboid in design.

For aesthetic reasons, dashes sometimes have rounded corners to make up for the deficiencies of the optical system and to eliminate a 'bulging' effect if sequential dashes are overlapped to form a rule.

The width of image and width of the space allocated can be:

1. Full Face
2. Not Full Face

A *Full Face* image design accomodates the full horizontal width allocated to the character and, if set adjacent to a similar character, will form a continuous line equal to the sum of the two elements. This characteristic sometimes permits the dash character to be called a Rule.

Not Full Face. The image design does not occupy the full horizontal width allocated to the character and if set adjacent to a similar character will show the appropriate amount of white space.

This characteristic sometimes qualifies the character to be called a Dash.

The Vertical position is usually such that the character, when composed in text, appears optically centered on the height of the lower case x.

Examples are:

a. EM Dash. Used for parenthetical expressions or emphasis, a hiatus or break, suspension or hesitation of speech, a sudden shift or uncertainty on the part of the speaker.

b. EN Dash. Used in numeric work, to indicate a range.

Data. (1) A representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation or processing by human or automatic means.

(2) Any representations such as characters or analog quantities to which a meaning is or might be assigned.

Data Bank. A comprehensive collection of families of data records. A data base.

Data Base. Same as data bank. A comprehensive collection of data. For example, one line of an account may form an item; a complete account may form a record (customer account); a complete set of such records may form a file (accounts file); the collection of inventory control files may form a library; and the libraries used by an organization are known as the data bank.

Data Flowchart. A flowchart representing the path of data through a problem solution. A flowchart defines the major phases of the processing as well as the various data media used. Similar to flowchart.

Data Name. An identifier or reference that unambiguously names an item of data.

Data Processing. The execution of a systematic sequence of operations performed upon data. Synonymous with information processing. May involve computation, ordering, etc.

Data Processor. A device capable of performing data processing, i.e., desk calculators, punched card machines, and computers.

Dead-line. The latest date or hour beyond which copy cannot be accepted.

Dead Matter. Type matter not to be used again; distinct from live matter.

Debug. To detect, locate and remove mistakes from a routine or to remove malfunctions from a computer or equipment.

Decimal. (1) Pertaining to the numeration system with a radix of ten. (2) Pertaining to a characteristic or property involving a selection, choice or condition in which there are ten possibilities.

Decimal Digit. In decimal notation, one of the characters 0 to 9.

Decimal Notation. A fixed radix notation, where the radix is ten; e.g., in decimal notation, the numeral 789.3 represents the number 7 × 10 squared, plus 8 × 10 to the first power, plus 9 × 10 to the zero power, plus 3 × 10 to the minus 1 power.

Decode. To apply a set of unambiguous rules specifying the way in which data may be restored to its previous representation, i.e., to reverse some previous encoding.

Del. The abbreviation for the delete character.

Delay Command. An instruction inserted in a stream of text data which will be acted upon at a subsequent point to be defined through the processing of text.

Delete. To eliminate, erase, take out or remove.

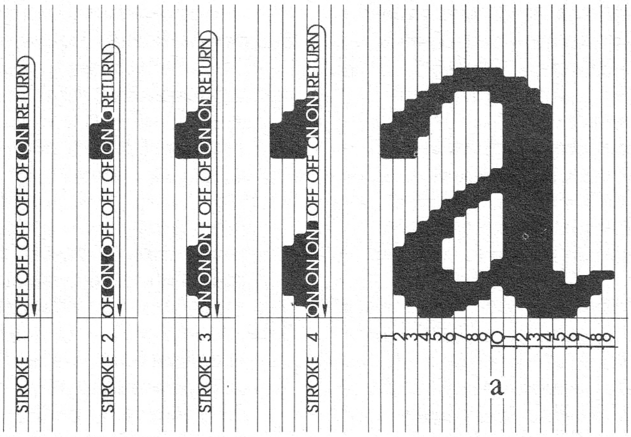
Delete Character. The character used to obliterate any erroneous or unwanted character; e.g., on a punched tape, the delete character consists of perforations in all punching positions. Synonymous with erase character, rub-out character.

Density. See Recording Density. The measurement of opacity of exposed and developed characters of text. On film base the measurement is from transmitted light and on paper base on reflected light. Density values are calculated using the logarithm of opacity on the scale.

The following examples give an indication of densities required for the various printing processes.

1. Intaglio (Gravure) 1.8
2. Planographic (Lithographic) 2.6
3. Relief (Letterpress washout plates) 3.0

It should be remembered that when increasing the light output to achieve high density, the character definition will be affected. With typesetting systems using a negative image master, the character acts as an aperture and will react accordingly when the light generated to pass through it increases or decreases. The emulsion on the photographic film and paper has a threshold and reacts differently according to the amount of light it is exposed to. Consequently, increasing and decreasing the density of the character image also changes the definition and size of the character. These changes affect the 'weight' of the character when viewed. To achieve acceptable results, particularly when text is set on different machines or at different times, close control has to be maintained over density.


STROKE 1
OFF OFF OFF OFF OFF ON RETURN
STROKE 2
OFF ON OFF OFF ON ON RETURN
STROKE 3
ON ON ON F OFF OFF ON ON RETURN
STROKE 4
ON ON ON OFF OFF ON ON RETURN
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9
a

The generation of a character (Garamond) on the cathode-ray tube. The character generates from left to right on a common base-line. The completely generated character appears exactly as shown at the right of the illustration. The small "a" (14 pt.) is a direct photographic reduction of the image on the tube; the "raggedness" is not apparent, but can be seen readily under a magnifying glass.

Figure 75. Digitised Character

Depreciation. A reduction in the value of a fixed asset because of use, wear and tear and obsolescence. It has the effect of reducing stated earnings.

Descender. The portion of a character that descends below the base line; lower case *g j p q y* are examples.

Diagnostic. Pertaining to the detection and isolation of a malfunction or error.

Diacritical Mark. An accent used most commonly in dictionaries, or encyclopedias, to indicate pronunciation. See Accent.

Dictionary. See Hyphenation.

Dieresis or Diaeresis. The accent-mark (¨) positioned over the second of two adjoining vowels to indicate a distinct pronunciation. Synonymous with umlaut when used in words of German origin.

Digit. (1) A symbol that represents one of the non-negative integers smaller than the radix; e.g., in decimal notation, a digit is one of the characters from 0 to 9. Synonymous with numeric character.

Digital. Refers to data in the form of digits or discrete units. Contrast with analog.

Digital Character. The term used to describe a block of digital information which when translated describes the outline of a character. See Figure 75.

Digital Computer. (1) A computer in which discrete representation of data is principally used. (2) A computer that operates on discrete data by performing arithmetic and logic processes on these data. Contrast with analog computer.

Digitize. To use numeric characters to express or represent data; e.g., to obtain from an analog representation of a physical quantity a digital representation of the quantity; i.e., a character is digitized and stored for subsequent use on a CRT typesetter.

Digraph. A joining of two letters, as "oa" in float and "sh" in shall.

Diphthong. A combination of two characters forming one sign to represent one sound (i.e., AE, ae, OE, oe)

Direct Access. Same as random access.

Direct Access Device. Same as random access device.

Direct Address. An address that specifies the location or position of an operand. Synonymous with one-level address.

Direct Insert Subroutines. Same as open subroutines.

Discounted Cash Flow. The return on invested capital computed in terms of yield. A rate of interest that will make the flow for an equipment purchase equal to the original capital investment.

Discretionary. That which is left up to choice such as a discretionary hyphen which may or may not be used in the printed material.

Discretionary Hyphen. See Hyphen.

Disk. See Magnetic Disk.

Display Tube. A tube, usually a cathode ray tube, used to display data.

Distributed Processing. Utilizing a multiplicity of processors (computers) each performing a given task or tasks, e.g., a system which uses one computer for editing, another for data base management and another for driving the typesetter. A preferred approach to electronic composition systems.

DLE. The abbreviation for data link escape character.

Document. (1) A medium with data recorded on it for human use; e.g., a report sheet, a book. (2) A record that has permanence and that can be read by man or machine.

Dot Leaders. A sign having a number of dots which are designed to assist referencing the beginning and end of a line which would otherwise have white space between the left and right hand text. Dot leaders are designed to sit optically on the baseline. Normally they are in groups of two, three or six. Some typesetters have a special program that utilizes the standard period and simply allocates additional spacing as required. This saves space on the matrix used to store the master characters.

Drop In. The reading or generation of a spurious signal whose amplitude is greater than a predetermined percentage of the nominal signal.

Drop Out. (1) In magnetic medium, a recorded signal whose amplitude is less than a predetermined percentage of a reference signal. (2) In data transmission, a signal received and modified due to the effect of noise or system malfunction.

Drum. See Magnetic Drum.

Dump. To copy the contents of all or part of a storage into the same or any other storage.

Duodecimal. (1) Pertaining to the numeration system with a radix of twelve. (2) Pertaining to a characteristic or property involving a selection, choice, or condition in which there are twelve possibilities.

Duplex. In communications, the ability to simultaneously and independently transmit in both directions. Contrast with half duplex. Synonymous with full duplex.

Duplex. The assigning of one width value to two signs because of a mechanical limitation or a need to conserve width table storage through a font. Thus one width table services two fonts. If more than two fonts address the same width table the fonts are designated 'multiplexed.'

Dynamic Dump. A dump that is performed during the normal execution of a computer program.

Dynamic Programming. In operations research, a procedure for the optimization of a multistage problem solution wherein a number of decisions are available at each stage or step of the process.

Dynamic Storage. A device storing data in a manner that permits the data to move or vary with time so that the specific data is not always available for immediate recovery. Magnetic drum and disk storage are permanent dynamic storage. An acoustic delay line is a volatile dynamic storage.

E

Edit. To modify the form or format of data; e.g., to insert or delete or move characters.

E.D.P. Electronic Data Processing. The recording, analyzing and reporting of data by use of a computer system — usually for business management and accounting purchases.

Effector Character. A control character used to cause a desired predetermined result.

Eight-Level Code. Any code representing a character set which uses combinations of eight channels in each frame or row. The eight levels are used for information and do not include parity.

Elite Type. A typewriter font that has 12 characters to the inch.

Ellipsis (Semantic Space.) The omission of one or more words indicated by the insertion of three dots. Often the dots are periods with appropriate space between.

EM. Is a term applied to the maximum fixed space value in each font. The absolute dimension is proportional to the point size in the vertical dimension and the set size in the horizontal direction of the font in question. Normally the Em space contains the maximum number of units of space specified by the typesetter's method of calculation; e.g., a typesetter with an 18-unit counting system would have an em of 18-units. Similarly a typesetter with a 36-unit counting system would have an em of 36 units.

On a typesetter with an 18-unit counting system a 7-point 8-set em would be 7 points high and 8 points wide. The absolute unit values of 1-18 are calculated by

$$\frac{8 \text{ pts. in inches} \times \text{No. units}}{(18)} = \text{inches}$$

On a typesetter with a 36-unit counting system a 9 point 10 set EM is 9 points high and 10 points wide. The absolute unit values 1-36 are calculated by

$$\frac{10 \text{ pts. in inches} \times \text{No. units}}{(36)} = \text{inches}$$

When a set size value is not indicated the value is equal to the point size; i.e., a 9-point em is 9 points high and 9 points wide. Therefore, in many cases the em is the square of the point size. Unit values are vertical subdivisions of the em width.

Sometimes the measure or line length is indicated as a number of ems; i.e., 20 ems. When ems are related to line length of measure, unless otherwise stated, the em value is based on 12 point 12 set.

More correctly this should be called a pica; i.e., 20 picas. Width of a pica is equal to the width of one em 12-point 12 set. See Pica and Measure.

Em Rule. See Rule.

Emulate. To imitate one system with another such that the imitating system accepts the same data, executes the same programs, and achieves the same result as the imitated system. Contrast with simulate.

Emulator. A device or computer program that can emulate.

EN Rule. See Dash, EN Space. Is a term applied to a fixed space value equal to one half of the em space value in the desired font.

ENS per Hour (EMS per Hour). A unit of measure used to evaluate the speed of text production by an operator or machine. The assumption is made that the average width of characters, signs, spaces, etc., set is equal to one en. In the case of EMS per hour it is assumed that an average two characters equal one em.

End Product. The material produced by the typesetter. In the case of phototypesetters, photographic film or paper.

ENQ. The abbreviation for the enquiry character.

Enquiry Character. A communication control character used to request a response from a remote station. The response may include station identification and, if required, the type of equipment in service and the station status. Synonymous with 'who-are-you.'

EOT. The end of transmission character.

Equipment Replacement. Exchanging existing equipment for new equipment to increase production or improve quality, lower costs, implement product changes.

Erase. To obliterate or delete information from a storage medium; e.g., to clear, to overwrite. See Delete.

Error Message. An indication that an error has been detected or encountered.

Escape Character. A method of code extension where a character is combined with one or more succeeding characters to form an escape sequence. This sequence indicates that the succeeding characters are to be interpreted differently. Abbreviated ESC. Synonymous with Flag Code or Supershift.

Escapement. The procedure by which the typesetter places characters side by side to form a line. The methods used to achieve this are:

1. Prism moving parallel to the photographic material.
2. Mirror moving parallel to the photographic material.
3. Lens moving parallel to the photographic material.
4. Mirror rotating to deflect the image across the photographic material.
5. Electron beam deflected across the face of the CRT for subsequent exposure to the photographic material.
6. Photographic material moved before a static optical path.

By whatever means it is achieved, the act of moving is referred to as 'escaping' the width of a character. First the character is selected then, normally, the character is exposed, and finally the width of the character exposed is escaped in readiness for the selection and exposure of the next character. This method builds up the line from the left to the right hand side of the line. In some cases typesetters set from right to left, in which case the character is selected, exposed and then escaped.

Estimating: Determining the price to quote a typesetting job based on a number of variables: manuscript pages, output pages, number of characters, number of lines, number of ems, area of type, number of galleys, hour of labor, hours of machine time.

ETB. The abbreviation for the end of transmission block character.

Etch Type. Type that is produced by direct etching of a printing surface by a laser, electron beam or other means.

ETX. The abbreviation for the end of text character.

Exception Dictionary. See Hyphenation. Words and roots of words which, if hyphenated by the logic rules, would be incorrectly hyphenated. The exception dictionary gives the proper hyphenation points. Alternatively, a dictionary of words which are exceptions to the normal hyphenation process.

Executive Routine. A master routine that controls the execution of other routines (programs). Synonymous with supervisory routine.

Extended Type (Expanded, Fat). A design of type in which the width of characters is greater in proportion to their width than in a normal type style.

F

FE. The abbreviation for the effector character.

Fetch. The portion of a computer cycle during which the location of the next instruction to be executed is determined. To obtain a program or date element from storage such as a fetch of a character width element from storage.

FF. The abbreviation for the form feed character.

Field. In a record, a specified area used for a particular category or type of data; e.g., a group of card columns used to represent a wage rate or a set of bit locations in a computer word used to express the address of the operand.

Figure Space. A space value equal to the space assigned to the figures in a particular font. Dependent on the system, either a separate value is stored or a figure location is addressed. The width is used for escapement and the character identity is inhibited; i.e., the character is not exposed. Used in tabular work to assist in aligning figures.

File. A collection of related records treated as a unit. For example, one line of an invoice or a take may form an item, a complete invoice or a story, may form a record; and the complete set of records or a chapter, may form a file; the collection of inventory control files or a book, may form a library; and the libraries or books used by an organization are known as its data bank.

File Gap. An area on a data medium intended to be used to indicate the end of a file, and possibly, the start of the next file. A file gap is frequently used as a flag to indicate the end or beginning of another group of data, or for other purposes.

File Layout. The arrangement and structure of data in a file, including the sequence and size of its components.

File Maintenance. The activity of keeping a file up to date by adding, changing, or deleting data as appropriate.

File Separator. The information separator used to identify a logical boundary between items called ‘files’. Abbreviated FS.

Film Advance. See Leading

Filmsetter. See Photocomposition

Filmsetting. See Photocomposing

Fit. A term used by printers to describe the horizontal position or relationship between two or more characters. The characteristic ‘Fit’ can be altered by modifying or changing the horizontal width (set width) assigned to characters. ‘Tight Fit’ is obtained by reducing the space assigned to characters and ‘Loose Fit’ is obtained by increasing the space assigned. Subjective terms such as Good and Bad Fit relate principally to the accepted standard or the convention of the day.

Flag Code. (Supershift) A code which changes the meaning of a subsequent character(s) code(s) in date. Synonymous with Escape Character. (1.) Any of various types of indicators used for identification, e.g., a wordmark. (2.) A character that signals the occurrence of some condition, such as the end of a word.

Flip-Flop. A circuit or device containing active elements, which can assume either one of two stable states at a given time.

Flowchart. (l) A graphical representation for the definition, analysis, or solution of a problem, in which symbols are used to represent operations, data, flow, equipment, etc. (2) See Data Flowchart.

Flowchart Symbol. A symbol which is used to represent operations, data, flow, or equipment on a flowchart.

Flush. Level, even, or on the same plane implies that indentions are not present. Text can be flush left or flush right; that is, aligning on the left or right respectively. Text can also be flush right and left (justified text).

Flying Spot Scanner. In optical character recognition, a device employing a moving spot of light to scan a sample of the material to be identified.

Folio. The sequential numbering of pages, normally with Arabic figures. One number is assigned to each page.

Font (Fount). A character set of a given size and style and face; e.g., 10-point Times Italic. See Type Nomenclature

Forbidden character. A combination of bits which is not valid or is in error if the combination occurs.

Foreground Processing. The automatic execution of programs that have preemptive use of the computer (processing) facilities. A real time program with highest priority.

Form Feed Character. A character which causes movement of the printing element to a predetermined position on the next form, page, etc.

Format. (1) The arrangement or sequence of data. (2) The overall specification of text or a job or work. Includes the typeface, style, size, leading, line length, margins, etc.

Forward/Reverse Leading. See Leading Reverse

Fraction. A numeric representation or sign denoting parts of a whole.

Fractions, Piece. A design of fractions contained on one graphic (or symbol) to which one width is allocated, i.e., a horizontal bar fraction $\frac{1}{4}$ $\frac{1}{2}$ or a diagonal bar fraction ¾, ⅜, 7/10 (fractions other than the commonly used ones which are combinations or composite signs of two or more characters).

Fraction, Built up (Split). 3—5 3/5
17—32 17/32

FS (File Separator Character). In USASCII, the name of the information separator used at the highest hierarchical level.

Full Duplex. Same as duplex. Circuits in which signals can be passed in both directions simultaneously.

G

Galley Proof (Galley Slip). A proof of text, normally in a column produced before the text is made-up into a page. A galley of type is traditionally less than 21″ in length. This size is convenient to handle, and constitutes a reasonable point at which to terminate keyboard to enable handling of paper tape.

General Purpose Computer. A computer that is specifically designed to handle a wide variety of problems.

Graphic. A symbol produced by a process such as handwriting, drawing, or printing.

Grave. An accent-mark (`).

Grotesque. The name used to describe the earliest type styles that do not have serifs. Abbreviated Grot.

H

Hair Space. See Spaces. The thinnest metal space made by typefounders, usually 6 to the pica em. A thin copper space, usually ½ point.

Half Adder. One half of a circuit used to perform binary addition.

Half Duplex. In communications, pertaining to an alternate, one way at a time, independent transmission. Contrast with duplex.

Hanging Punctuation (Optical Line-up). To achieve optical alignment or the aesthetic appearance desired, punctuation appearing on the right hand side of the column is set outside the normal line length. The punctuation is set in the column spaces and hangs out from the line.

Hardcopy. The product of a typewriter or computer peripheral printing device. A paper record showing text information with as much detail as the character set of the device will allow. In typesetting, hardcopy is generated to be used as a proof prior to entering the typesetting system. The hardcopy cannot parallel the way the text will be set on the typesetter and does not necessarily give a code-for-code or keystroke-for-keystroke representation of the text material.

Hardware. The physical equipment, as opposed to the computer program or method of use; e.g., mechanical, magnetic, electrical, or electronic devices. Contrast with software.

Head. A device that can read, write, or erase data on a storage medium; e.g., a small electromagnet used to read, write or erase data on a magnetic drum or tape; or the set of perforating, reading or marking devices used for punching, reading or printing on paper tape.

Header Card. A card that contains information about the data in subsequent cards.

Hierarchical. In ranked order. Classification of items by rank or order.

Hierarchical Access. Allowing retrieval of files based on a priority. Top priority can access all files. Lowest priority has access to the smallest number of files.

House Corrections. The printer's term for errors which need correction due to mistakes made by employees of the printer.

Horizontal Rules. See Rule.

Hot Type. Type that is set utilizing a molten metal casting process.

HT. The abbreviation for the horizontal tabulation character.

Hybrid Computer. A computer design for data processing using both analog representation and discrete representation of data.

Hyphen. A punctuation mark used to divide or to compound words or word elements. In typesetting there are three types of hyphens:

1. Obligatory (Mandatory) Hyphen
2. Discretionary Hyphen
3. Automatically-generated Hyphen (computer hyphen).

Obligatory (Mandatory) Hyphen. A hyphen which cannot be deleted to improve the typographic appearance of text.

Discretionary Hyphen. A hyphen which is inserted in a word, normally at the original keyboarding, and can be used if subsequent processing places the word at the end of a line and the line break at the point of the discretionary hyphen is preferred to the line break at the end of the word. If the end of the word is preferred, the discretionary hyphen is dropped and if the word is positioned other than at the end of the line the hyphen is dropped.

Automatically-Generated Hyphen. A hyphen inserted automatically by a justification and hypenation routine in a word to achieve the desired typographic result. On subsequent processing the automatically hyphenated word may be positioned so that the word need not be hyphenated and therefore the hyphen is eliminated.

Hyphenation. When it is not possible to justify a line by the prescribed expansion of the interword spaces nor by the insertion of the next complete word, the last complete word in the line must be divided at an acceptable place, the hyphen inserted, and the balance of the word moved to the next line.

When computers are used for typesetting, a program or routine is produced for hyphenation. The hyphenation routine works in conjunction with the justification routine. Hyphenation is achieved by the following:

1. Discretionary hyphen
2. Logical rules
3. Exception dictionary

Discretionary hyphen. See Hyphen.

Hyphenless Justification. Justification achieved without resorting to automatic hyphenation generation.

Logical Rules. A series of algorithms which examine or analyze the word. The analysis is to ascertain prefix and suffix groups, consonant and vowel combinations and other letter groupings which are acceptable or nonacceptable places to hyphenate. The logic rules or algorithms can be extensive to achieve a great degree of accuracy. Extensive rules result in long processing time (hyphenation time). No logical rules will ever give 100% correct hyphenation. Apart from the idiosyncrasies and exceptions of each language, pitfalls such as homographs and the requirement of the spelling when some words are hyphenated, make logical rules impractical for perfect hyphenation. Often the set of logical rules are assisted with an exception dictionary.

Exception Dictionary. A selection of words, which if hyphenated by the logical rules, would be incorrectly hyphenated. They are therefore stored with the correct hyphenation. The exception dictionary is normally accessed prior to the logical rules and if a word is 'found' in the exception dictionary the appropriate hyphenation is taken and the rules are not used. The words are therefore 'exceptions' to the particular logic rules. Different sets of logical rules often require a different set of exception words.

In addition to words with correct hyphenation, words which should not be hyphenated are stored in the exception dictionary; i.e., proper names, place names, etc.

The definition of what is 'Perfect Hyphenation' is quite undefinable. Suffice it to say that if nobody complains, the hyphenation is good and if they do, it is bad.

It must be remembered that the exception dictionary is normally accessed and searched prior to entering the logical rules. A prime requisite for the method used to access and search the dictionary is speed. Consequently the dictionary is often stored in core or virtual memory.

I

Illegal Character. A character or combination of bits that is not valid according to some criteria; e.g., with respect to a specified alphabet, a character that is not a member of that alphabet. Contrast with forbidden character.

Image. (Image Area). The area occupied by the character area as opposed to the width or space allocated to the design. The maximum horizontal image dimension together with the side bearings give the character's set width.

Immediate Access Store. A store whose access time is negligible in comparison with other operating times.

Immediate Address. Pertaining to an instruction in which an address part contains the value of an operand rather than its address. Synonymous with zero-level address.

Immediate Leading. See Leading.

Imprint. The name and address of a printer or publisher on the title page of the book usually with the date and place of publication and any other pertinent information.

Indent (Indention). Is the placement of a selected portion of text so that the beginning or the end (or both) of the line(s) of the selected text does not align with the margins of the main text.

Center Indent. (Left and right indent). The starting and finishing point of each line of the selected text is displaced a defined amount from the left and right margin.

Hanging Indent. The first line of text in a defined block is to the full measure and all subsequent lines are indented a defined amount. The indent can be left, right or center.

Left Indent. The starting point of each line of the selected text is displaced a defined amount to the right of the main text margin.

Multiple Indent. Text where various indent values are used dependent on the type of text being set; often used in learned and scholastical work.

Dependent on the system, an indent may continue until a 'cancel indent' instruction is reached. Alternatively, there may be self-cancelling after reaching a defined location or a number of lines of text have been processed. See Run Around. Other typographic techniques use the indent procedure. See Skew.

Paragraph Indent. (First line indent). The beginning of each paragraph is started with a defined space so that the first line is indented from the subsequent text in the paragraph. This term can also apply to an indentation which is for a defined paragraph of text that is indented from the main text.

Right Indent. The finishing point of each line of the selected text is displaced a defined amount to the left of the main text margin.

Text Indent. (Variable hanging indent). Similar to a hanging indent except that the value of the indention is determined by a defined point of text in the first line.

Index. (1) An ordered reference list of the contents of a file or document. Together with key words, characters, or reference notations for identification or location of those contents. (2) To prepare a list as above.

Index Register. A register whose content is added to or subtracted from the operand address prior to or during the execution of a computer instruction.

Indexed Address. An address which is modified by the content of an index register prior to or during the execution of a computer instruction.

Indirect Address. An address that specifies a storage location that contains either a direct address or another indirect address. Synonymous with multilevel address.

Inferior (Subscript). Characters of a smaller design than normal characters and positioned below the baseline. The characters are used in mathematical setting to qualify and modify the main text, and in straight setting as reference points and distinguishing marks.

Design of inferior characters should be different from the main text. However, it is possible to use a smaller point size character with the main text and with appropriate leading adjustment to simulate an inferior character.

There are two main levels in mathematics for superior and inferior characters: 'first order' and 'second order.'

Inferior by character. A routine which automatically selects the next character as an inferior and then returns to the main text.

Inferior by block. A routine which automatically changes from the main text to inferior characters until cancelled.

Information Separator. A control character used to delineate a block of information.

Initial. The first letter of a name, a large or decorative letter beginning a text, a division, or a paragraph.

Initial, Drop. The style where the first letter is 'inset' into the text and the top of the letter aligns with the top of the first line of text.

Initial, Raised. The style where the first letter aligns at the base with the first line of text and the balance of the letter rises above the first line of text.

Input. (1) Same as input data. (2) One, or a sequence of input states. (3) Same as input device. (4) Same as input channel. (5) Same as input process. (6) Pertaining to a device, process, or channel involved in the insertion of data or states, or to the data or states involved. (7) See Manual Input.

Input Area. An area of storage reserved specifically for input. Synonymous with input block.

Input block. Same as Input Area.

Input Channel. A channel for impressing a state on a device or logic element.

Input Data. The data to be processed.

Input Device. The device or collective set of devices used for conveying the data into another device.

Input Speed. The rate at which characters are translated into machine form. Rates vary from seven characters per second for straight matter to two characters per second for complex matter involving a large number of keystrokes.

Interword Space. See Spaces.

Interrupt. Stop a process in such a way it can be resumed.

Interword Space to Zero. See Spaces.

Instruction. (1) A statement that specifies an operation and the values or locations of its operands. In this content, the term instruction is preferable to the terms command or order which are sometimes used synonymously. Command should be reserved for electronic signals, and order should be reserved for sequence, interpolation, and related usage. (2) See computer instruction, decision, instruction, extract instruction, logic instruction, machine instruction, macro instruction, repetition instruction.

Instruction address. The address that must be used to select (fetch) an instruction. Contrast with address part.

Instruction code. Synonymous with Operation Code.

Investment Credit. A tax credit for investments in specified types of property in addition to normal depreciation deduction.

I/O (Input/Output). Input or output or both.

IS. The abbreviation for an information separator.

ISO. The abbreviation for the International Organization for Standardization.

J

Job Docket. Paper work indicating customer, job specification, and time spent in each phase of production cycle.

Julian Calendar. A calendar in which days are numbered consecutively up to 365 for a non leap year and 366 for a leap year. Accumulated leap year error was corrected by the Gregorian calendar.

Justification (To Justify). To adjust or arrange text to fill exactly a measure or defined area so that lines of the same measure have aligned margins.

Justification is necessary because the text characters have different widths (see Proportionally Spaced Characters) and the numbers of characters in a line varies according to the text.

To achieve a uniform measure, spaces of variable widths are selected to expand or contract the text to comply with the specification of the measure. The value of spaces between words from line to line will vary. Within a line normally two values of space will be used. The occurrence of identical spaces throughout a line or from line to line will normally be coincidental.

The formula for justification is:

$$M - cw - VW = \text{Deficit}$$

$$\text{Deficit}/W = A$$

$$M - cw - VW - AW = o,\ V + A = S$$

Where M=Measure value, cw=Character Widths in line, V=Interword variable space nominal value, Deficit=Amount left in line for distribution through interword spaces to achieve justification, W=Number of interword spaces in a line, A=Value to be added to the interword spaces to achieve justification, S=Word space value through the line to achieve justification. Note the word space (S) in a line usually has two values that vary by 1 unit.

In addition, to assist in achieving aesthetically pleasing results and evenness of 'color,' words are hyphenated and spacing between letters (letterspacing) is used. See Hyphenation, Letterspacing and Spaces.

Justification Routine (Program). The name for the method by which a computer program achieves justification.

The basic steps of computer justification are:

a. Define the measure.

b. Assemble the characters and interword variable spaces in the line.

c. Deduct the character and interword variable space total from the measure.

d. Check to see if the result is equal to or less than 0.

e. If the answer to "d" is yes, carry on from "c" until the next interword space.

g. Deduct the value of characters in the last word.

h. The positive value remaining is the deficit or justification zone, the position at which justification will be acceptable.

Justification Zone. The point at which the text has been split into a group of words that must be processed by the justification routine.

Justify Inhibit. To stop or 'disconnect' the justification routine so that text is processed without being justified.

K

K. (1) An abbreviation for the prefix kilo, (1000 in decimal notation). (2) In automatic data processing, loosely, two to the tenth power. 1024, in decimal notation.

Kern (Mortising). The manipulation of character widths to achieve aesthetically pleasing results. The juxtaposition of certain characters creates the optical impression of excessive or minimal spacing. This is basically due to the varying shapes of characters and the varying combinations of characters that are used.

Typical examples of character combinations that are kerned are shown in Table 18.

Va	Yi
Te	Wo

Table 18. Kerned Character Examples

In photocomposition, kerning is achieved by reducing the space allocated to one of the characters where optically too much white space occurs. In other words the reduction of a character width places the character images close together and improves the visual effect. In hot metal composition with the Monotype system, kerned characters can be cast as a matter of course. In photocomposition with a two dimensional medium film, complete freedom is possible in the placement of character images. The terms Kerning and Mortising have therefore become synonymous.

Keyboard. See Perforator. A device for the encoding of data by a key depression, which generates a selected code element.

Keyboard Chart. A chart constructed to show effective keyboard rates for different types of text such as straight matter, foreign language, technical terms, display, complex display.

Keyboard Layout. The spatial positions of the keyboard character (sign) keys.

KPH (keystrokes per hour). The total of text and command code that are keyboard entered by an operator in one hour.

L

Laser. An acronym for light amplification by stimulated radiation. Produces coherent light subject to normal optical manipulation but which does not have many of the undesirable drawbacks of normal light.

LCA. Abbreviation for lower case alphabet.

Lead, Zero (Line Feed Inhibit). A command which, for one line, overrides the leading value which would normally be advanced and sets the second line on top of the first line.

Leader. A character consisting of two or more dots set in a row. When set adjacent, the leaders form a dotted line. Text is 'leadered out' by inserting leaders between text on the left and right hand side of the line. The leader is used in lists, directories, tables of contents, etc. to 'lead' the eye from the left hand text to the right hand text in the line.

The design of a true leader differs from a full point. However, on some systems a Leader Command accesses the full point character and automatically allocates addition space to simulate the effect of leadering; this is done to save character positions on the matrix. This will often result in increased setting time because each dot requires one exposure as opposed to using leaders which will have a multiple number of dots for each exposure. The precise number is determined by the leader design.

Leaders can be vertically aligned. It is more difficult to vertically align leaders because more calculations are necessary to align the dots.

Leader, Insert (Full with leaders, leader out). An automatic routine which will insert the required character(s) at a defined position in the line to achieve justification of the line by the insertion of the appropriate number of characters. The routine does not require any calculation on the part of the operator, simply a command instruction and the location in the line where leaders are to be inserted.

In some cases this routine can be used to insert space (blanks) between text or any nominated character. This is referred to as:

Insert Blanks (Space)
Insert Character

Leading. (Film advance forward leading). The term used to describe the amount of space between lines of text in excess of the amount of space allowed for each line. If the space value is quantified in points, twelve point text set 'solid' would have twelve points of space for each line. The value is calculated by measuring from 'baseline to baseline; for a block which is a convenient subdivision of a larger amount; e.g.

72 points = 6 lines of 12 point

Twelve point text set on 18 point requires six points of (additional) leading; e.g.

66 points = 4 lines of 12 point + 3 × 6 points

When measuring the baseline of a block of solid text, the total amount is equal to the space allocated to each line. When doing it for 'leaded' text (or text with additional space added between the lines of text) the total value of space allocated to each line plus the additional leading value minus one is recorded. The additional value of leading is not detected because the space has no visable parameters defining it. Normally, leading is inserted above the next line to be set on phototypesetters, and below the next line to be set for hot metal typesetters. This can only be detected at the beginning or end of a block. The mark-up personnel must know the sequence of operations of the typesetting device to be able to insert leading correctly. Equally, the keyboard operator or computer program must be aware of the operational sequence so that the beginning and ending of instructions may be selected to give the desired result.

On a phototypesetting machine, leading is normally achieved by mechanically driving the photographic material past the exposure point the required number of points at the end of each line of text. However, on some CRT typesetters the leading is achieved electronically by displacing characters on the face of the CRT. This can be for a number of lines or in some cases the complete page.

On all phototypesetters there is no theoretical restriction on the maximum or minimum amount of leading or space which can be allocated to text. It is possible to reduce the 'normal' value allocated to a typeface to zero or add to it an infinite amount.

Leading Programmed (Line Feed). The vertical space allocated to a line of text. Because a command remains active until cancelled or altered, the current value of leading is normally advanced by the typesetter each time the carriage return (line end, end of line) code is read.

Leading, Reverse (Forward/Reverse). This term refers to the ability of the typesetter to move the photographic material in the opposite or reverse direction. This facility is used to achieve typographic effects and to place blocks of text next to one another. (i.e., the sequential laying down of multiple columns side by side for area or page composition.)

Leading Additional (Secondary). The vertical space to be inserted once at the end of the line in which the instruction occurs. Normally a value quantifying the command is given making the command variable. In some cases the value for Additional Leading is manually described; the command is not variable from a tape input.

LED (Light Emitting Diode). Diodes that emit light. They are used for indicators and have extremely long life. They are less than one tenth of an inch in diameter and are used in arrays to present alphanumeric information.

Letter. A graphic, which, when used alone or combined with others, represents in a written language one or more sound elements of the spoken language; diacritical marks used alone and punctuation marks are not letters.

Letterspacing. Space inserted between characters, letters, or signs in addition to the amount of space normally allocated. The space is inserted to achieve an aesthetic effect, to lend emphasis, to distribute space through the line, to assist or achieve justification.

Normally the letterspacing value is defined and the point in the text at which it commences is indicated and remains in effect until cancelled. The letterspace value is added to (inserted between) each character. If letterspacing is required or is necessary throughout the line the last character set should not be allocated the space otherwise the appearing measure (line length) will be reduced by the value of the letterspace.

On typesetting machines that set text from left to right, letterspacing is inserted on the right hand side of the character. On machines that set from right to left the letterspace is inserted on the left of the character.

Letterspacing is quantified by the smallest unit or increment of space and can be based on points or set widths. Whatever the base, the normal input procedure on a perforator or input to a typesetting program is to insert an equally defined amount of space between each letter, irrespective of the character's design, for the portion of text specified. This procedure is sometimes referred to as 'Mechanical Letterspacing'.

Letterspacing, Visual. The insertion of variable amounts of space between letters, characters or signs to achieve the visual effect of 'even' space between characters letters or signs. The amount of space is variable depending on:

(a) The design of character, letter or sign
(b) The juxtaposition of signs in the line
(c) The maximum 'visual' space created in the defined block of text by the juxtaposition of particular signs.

Because of the number of variables encountered, the value of each letterspace is left to the discretion of the operator who determines the amounts required from 'visual' experience.

LF. The line feed character.

Ligatures. A graphic consisting of two or more signs on one design and allocated one width. The ligature needs a special code or can be automatically detected in the text and the special code generated automatically. In the English language the most common ligatures are ff, fl, fi, ffi, and ffl.

Decorative forms of combined characters are sometimes referred to as Quaint.

Lightface. A design of type style in which the image area is less in proportion to the width than normal typestyles.

Line feed character. A format effector that causes the printing or display position to be moved to the next printing or display line. Abbreviated LF.

Line Length. See Measure.

Line printer. A device that prints all the characters of a line as a unit rather than one character at a time as a character printer.

Literal. Grammatical or typographic error in the text.

Live Matter. Type matter which is to be held, or used for printing.

Logotype. A ligature or any other combination of characters, words or phrases produced as a single graphic and allocated a given width.

Longitudinal Redundancy Check Character. A character utilized to check the accuracy of a block of reported data.

Long Letters. Letter designs that occupy the maximum area and include an ascender and descender, e.g., Q.

Lower Case (l.c). The set of small letters as distinct from capitals and small capitals. The uncapitalized letters in the alphabet.

Lower Magazine. The name given to the lower magazine on a linecaster. These have an associated code in TTS to allow the linecaster to automatically change magazines and hence typeface. In some cases the name applies to the code (01245) and often (not always) indicates a typeface change function.

LPM (Lines per Minute). A unit of measure for expressing the speed of a process. To be meaningful the typestyle, size, and leading should be specified. Commonly the term refers to single column newspaper text of approximately 30 characters per line, measure 10½ — 11½ picas, 8 or 9 point type with 8 or 9 point leading.

LRC. The abbreviation for the longitudinal redundancy check character.

M

Machine Code. An operation code that a machine is designed to recognize and react to.

Machine Instruction. An instruction that a machine is designed to recognize and can execute.

Machine Language. The language that is used directly by a machine (computer).

Machine Readable Medium. A medium that can convey data to a specified sensing device. Synonymous with automated data medium.

Machine Unit (Basic Unit, Fundamental Unit). The base unit on which all other unit widths and space allocations are calculated. Often the machine unit is such a small value the typesetter cannot mechanically interpret a Single Machine Unit. The smallest apparent escapement is therefore a multiple of the Machine Unit.

Machine Word. Synonymous with computer word. A sequence of bits or characters treated as a unit or capable of being stored in one computer location.

Macro Instruction. An instruction presented in a source language that is equivalent to a specified sequence of machine instructions.

Macroprogramming. Programming using macro instructions.

Magazine. The name of the unit on a line caster which contains matrices. In some cases a line caster will have two magazines referred to as the upper and lower magazine. Normally each magazine holds 90 matrices with two characters on each matrix. Each level on a matrix is called a row, either upper or lower. Each unit has a corresponding TTS code to enable paper tape selection.

Magnetic Core. A configuration of magnetic material that is, or will be, placed in a spatial relationship to current-carrying conductors and whose magnetic properties are essential to its use. It can be used to concentrate an induced magnetic field as in a transformer induction coil or armature, to retain a magnetic polarization for the purpose of storing data, or for its nonlinear properties as in a logic element. It may be made of iron, iron oxide, or ferrite, and in such shapes as wires, tapes, toroids, or thin film used to store computer data. An element commonly used for computer memory.

Magnetic Disk. A flat circular plate with a magnetic surface on which data is stored by selective magnetization of portions of the flat surface.

Magnetic Drum. A right circular cylinder with a magnetic surface on which data is stored by selective magnetization of portions of the curved surface.

Magnetic Storage. A storage device that uses the magnetic properties of materials to store data; e.g., magnetic cores, tapes, and films.

Magnetic Tape. (1) Tape with a magnetic surface on which data can be stored by selective polarization of portions of the surface. (2) Tape of magnetic material used as the constituent in some forms of magnetic cores.

Main Frame. Synonymous with central processing unit.

Manuscript. See Copy (Manuscript)

Marked Point. A defining of a previously undefined point in the text to which you need to return. Used when checking cross references, in text editing, correcting, etc.

Mass Storage Device. A device which has a large storage capacity, e.g., magnetic disk, magnetic drum.

Master File. A file that is either relatively permanent, or that is treated as the principal authority in a particular job.

Mathematical Check. A check that uses mathematical identities. An arithmetic check.

Mark-up. Prior to keyboarding, copy is reviewed and the instructions relating to typographic style are written or 'marked' on the copy (hence the term mark-up). Depending on the complexity of the work, mark-up can be simple or complex. Often simple mark-up is consistent with the type of the job and will be mentally noted by the keyboard operator making it unnecessary to repeat the instructions on the copy.

Matrix. The generic term used to describe the smallest independent unit used to 'store' or reproduce a character, letter or sign. Originally in hot metal, the matrix was the mold used to cast each character. In phototypesetting the master character is a negative and contains usually not one, but many characters which form a character set. The matrix is not restricted to one character set and may have several — all contained on the one matrix. Examples of methods used to 'store' or hold negative matrices used in phototypesetting machines are:

1. Disk
2. Drum
3. Grid
4. Film Strip

Each matrix has a defined number of points or character locations in which a character is located.

Often more than one matrix may be installed in the phototypesetter at one time. One exception to the rule is the Monophoto 400 which still has, as its smallest unit, a character which is in an individual matrix. The matrices are assembled into a die case which constitutes the total character storage of the system. Usually the master image on the matrix can be optically enlarged and reduced to give the point size range or a portion of it as required. Some systems will only reproduce one size or limited sizes from one master and it is necessary to have more than one master to cover a given point size range.

Matrix. (Computer) (1) In computers, a logic network arranged in the form of an array of input leads and output leads with logic elements connected at some of their intersections. (2) A two-dimensional rectangular array of quantities.

Matrix Storage. The elements of which are arranged so that access to any location requires the use of two or more coordinates, e.g., cathode ray storage, magnetic core storage.

Measure, (line length). Text is set to a pre-defined length or width. This value is called the measure and can be quantified by any units; it is usually expressed as picas and points. The measure determines the left and right margins. Within the line, text can be placed anywhere; i.e., quad left, right or center; indented left, right or center; or set ragged left, right or center.

Merge. To combine two or more groups of text into one. Used when correcting and updating text.

Message. An arbitrary amount of information of data whose beginning and end are defined or implied.

Micro Instruction. A basic or elementary machine instruction.

Microprogramming. Programming with micro instructions.

Minus Spacing. See Set Width.

Mixing. The ability or act of combining in one word, line, block or text, more than one typeface, style or point size. The total mixing capability is determined by the ability of the typesetter. Often several type styles in several point sizes are freely intermixable in a line.

Mortise. See Kerning

Multijust. (Multiple Justification, Tab Setting, Tabular Setting). The procedures of setting given blocks of text at defined points within a measure.

Multilevel Address. An address that signifies a storage location that contains either a direct address or another indirect address. An indirect address.

Multiple Flash. Exposing a character more than once without moving the escapement. This occurs when: (a) More light is required to achieve the required density (usually in the larger point sizes), (b) The 'weight', hence the dimensions, need to be increased to lend emphasis. Used instead of a true Bold Face.

Multiprocessing. The simultaneous execution of two or more computer programs or sequences of instructions by a computer or computer network. Often referred to as parallel processing.

Multiprocessor. A computer that can execute one or more computer programs employing two or more processing units under integrated control of the programs or devices.

Multiprogramming. The concurrent execution of two or more programs by a computer.

N

Nest. To imbed subroutines or data in other subroutines or data at a different hierarchal level so that the different levels of routines or data can be executed or accessed recursively. Used for typographic formats.

Net Income/Net Worth Ratio. A ratio which expresses net income to net worth and demonstrates management efficiency in producing net earnings on the capital invested in the enterprise.

Net Present Value (NPV). A method of evaluating investments similar to the discounted cash flow, in that the cash flows are tabulated over the life of the investment. However, a discount rate which represents the cost of capital is used.

New Line Character. A control character which causes the printer or typesetter to begin a new line.

NL. The abbreviation for the new line character.

No Escapement. See Set.

No Flash. See Multi Flash.

No Photo. See Multi Flash.

No Set. See Set Width.

Number. A mathematic entity that can indicate quantity or amount of units.

Numeral. (1) A discrete representation of a number. For example; ten, 10, ×, 1010, are four different numerals that represent the same number. (2) A numeric word that represents a number.

Numerals. Aligning (Modern). Numerals that are aligned with the normal baseline 1234567890.

Numerals. Non Aligning (Old Style). Numerals that in some cases descend below the normal baseline.

Numerals — Arabic. One of the common number symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

Numerals, Roman. The numeric representation using I, II, III, IV, V, etc.

O

Object Program. A fully compiled or assembled program that is ready to be loaded into a computer. Synonymous with target program.

Obligatory Hyphen. See Hyphenation.

OBR. Optical Bar Reader. A machine to translate optically coded marks into character codes.

OCR. The abbreviation for Optical Character Recognition.

Octal. (1) The characteristic or property involving a selection, choice or condition in which there are eight possibilities. (2) The numeration system with a radix of eight.

Odd-Even Check. Same as Parity Check.

O.K. A mark used to indicate that a proof has no errors.

O.K. with Corrections. A mark indicating that, except for a few corrections, proof is approved and satisfactory.

O.K.'d Proof. The proof bearing the O.K. or approval of the originator or some other person able to pass upon its correctness, signifying that it is correct and ready to be printed.

Old Style Figures, (See Numerals, Non-Aligning).

One-line Initial. An initial letter larger than the text and aligned at the bottom with the text.

Open. Widely spaced.

Open Matter. Type matter the lines of which are widely spaced as distinct from Close Matter.

Open Punctuation. Sparse pointing, without the too free use of commas.

Open Subroutine. A subroutine that must be relocated and inserted into a routine at each place it is used. Synonymous with direct insert subroutine. Contrast with closed subroutine.

Open Quote. The beginning of a quotation marked by inverted commas.

Optical Character Recognition. Machine identification of printed characters through the use of light sensitive devices. Abbreviated to OCR. Contrast with OBR.

Optical Scanner . A device that optically scans printed or written data and generates their digital representatives.

Operand. That which is operated upon. An operand is usually identiified by an address part of an instruction.

Operating System. Software which controls the execution of computer programs and which may provide scheduling, debugging, input/output control, accounting, compilation, storage assignment, justification, hyphenation, data management, and related services.

Ordinal Number. A number which indicates the order or succession, as third, fourth, fifth, etc., as distinguished from cardinal numbers.

Output. (1) Same as output data. (2) One, or a sequence of, output states. (3) Same as output device, e.g., in typesetting the film (paper) produced by the typesetter.

Output Data. Data which is to be delivered from a device or program, usually after some processing. Synonymous with output.

Output Device. The device or collective devices used for conveying data out of another device. Synonymous with output.

Overmatter. Surplus matter at the end of a job, page or article. Overmatter is either saved for subsequent use, killed, or the portion of text affected is edited to make room for it.

Overset Line. A line which exceeds the specified measure and does not achieve a desired typographic effect.

P

Packing Density. The number of useful storage cells in each unit of dimensions; e.g., the number of bits per inch stored on a magnetic tape or drum track.

Page-proof. The proof of type matter made up into page form.

Paging. (1) Making up into pages. (2) Folioing or numbering of pages.

Paper Tape. The raw material used to record data. In common usage there are two widths ⅞″ for 6 - level and 1″ for 7-and 8-level coding. The tape can be impregnated with oil to assist perforating, oil free to assist reading or manufactured from mylar or some other long life material.

Paragraph Mark (¶). The sixth reference mark. Marks the point where a new paragraph should begin.

Paragraph. A subdivision of text consisting of one or more sentences. Deals with one point or gives the words of one speaker.

Parallel Mark (‖). The fifth reference mark.

Parity Bit (Parity Check). A method of verifying or checking the accuracy of a transferred or transmitted bit pattern using a summation check.

Parity, Horizontal. A summation check or verification for each frame or character.

Parity, Longitudinal. A summation check or verification for each channel or level group in a block.

Parity, Odd-/Even. To describe the system of parity checking or verification which, after summation, results in an acceptable odd or even answer.

Perforator. A keyboard unit which produces code on punched paper tape.

Perforator, Non-Counting. A unit which has the ability to punch into paper tape each character and function code required for subsequent processing but does not have the ability to store character widths.

Perforator Counting. A unit which not only punches into paper tape the coding structure required but also can store the widths of characters for the subsequent processing of text. By storing the character widths, it is possible for the operator to receive visual feedback of counting information based on the width of characters stored. This information allows the operator to make justification and hyphenation decisions.

PERT. An acronym for Program Evaluation and Review Technique — a mathematical method for determining the minimum time needed to complete a complex project while at the same time pointing out the items which need critical attention as the project progresses.

PEs (Printers errors): Errors made in the process of copy preparation and typesetting that are not in the original author's manuscript.

Pica. The normal unit of measurement for width and depth of type. Based on the Anglo/American point, a pica (or 12-point em) is equivalent to 0.166″.

Pi. *noun;* Type matter that has been placed out of sequence or order. *verb;* To mixup type matter.

Pi Character. A character, letter or sign which is not normally carried in a character set but is required to set a particular piece of text. Pi characters can be reproduced in two ways: (a) Blocks (Pi fonts) (b) Individual characters.

(a) On all phototypesetting systems it is possible to purchase matrixes with locations normally reserved for standard character sets occupied by a set of the 'most commonly used' pi characters. This set of pi characters has been selected by the manufacturer to satisfy most needs for peculiar signs. The method, selection, exposure, etc., of the pi characters is similar to that adopted for standard characters.

(b) Some phototypesetting systems offer a separate system for storing, manufacturing, selecting and exposing pi characters. With these systems quite often the printer can manufacture the pi matrix master himself thus saving time and expense.

Piece Fractions. See Fractions.

Phototypesetting, (Filmsetting). The terminology for the "new" (electronic to photographic) typesetting methods is somewhat confusing and is based on: (1) Erratic evolution. (2) The desire of each manufacturer to be different and establish his own standard.

While recognizing many reasons for and against the following definitions, for the sake of consistency and in an effort to improve the mutual understanding of all people involved with typesetting, the following is recommended:

(a) Phototypesetting. The production of textual typesetting usually in galley form.

(b) Photolettering. The production of display or headline typesetting usually in galley form.

(c) Photocomposition. The production of both text and display typesetting in position usually as area composition or page form.

Photographic typesetters are categorized by:

(a) Photo/Optic
(b) Photo/Scan
(c) Digital/Scan

Point, Anglo/American. The normal basic unit of measurement which is 0.01383″, approximately 1/72 of an inch. 12 points equal one pica. Note: each manufacturer's basic unit can be such that the point value is slightly different. Prior to the introduction of the Point System, typesizes were referred to by name. To this day some of the terms are in common usage. The following table shows the original names and the nearest equivalent point size.

4½ point	Diamond
5 point	Pearl
5½ point	Agate
6 point	Non Pareil
7 point	Minion
8 point	Brevier
9 point	Bourgeois
10 point	Long Prime
11 point	Small Pica
12 point	Pica
14 point	English
16 point	Columbian
18 point	Great Primer

Point, Didot. The basic unit of measurement used on the continent of Europe, 0.0148 inch 12 points equal one cicero or *corps douze*.

Point, Size of Type. The vertical space allocated to a typeface to encompass ascending and descending characters with sufficient additional space so that neither will overlap when set in text. The point size of type refers to space allowed for a given typeface and in no way refers to the type image area which can and does vary considerably from face to face. See Image Area. See Figures 76 and 82.

Pointing. Punctuation.

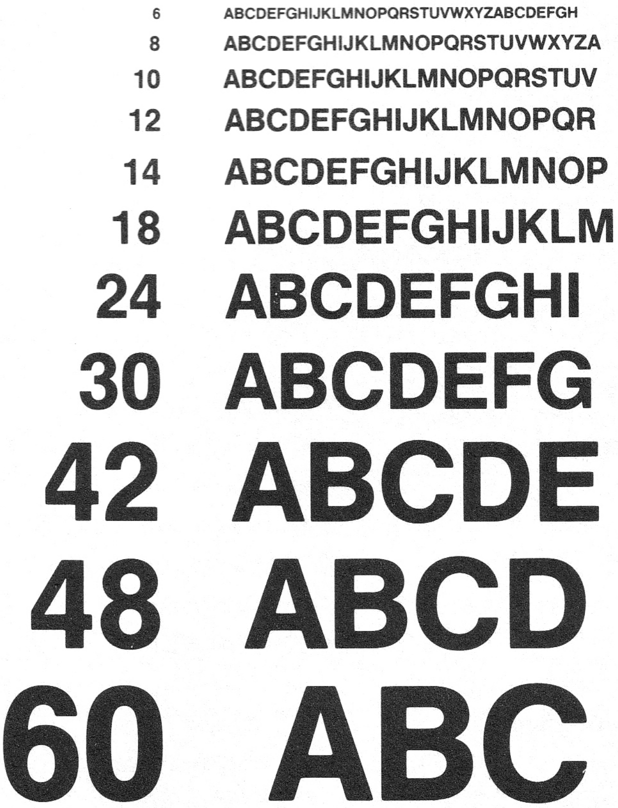
Position Independent. A program that can run in any location in core.

Positive Spacing. See Spaces.

Primary Letters. Lower case letter designs which do not have ascenders or decenders, i.e., *a c e m n o*, etc.

Production Cycle. The steps the work flows through to become final product steps may include: markup, keyboarding original, keyboarding corrections, typesetting, proofreading, corrections, page make up, and author's alterations.

Profit Planning. Planning by the factors which affect profit (price, volume, cost, etc.). Coordination of these factors to achieve the balance among them that will result in the highest profits.



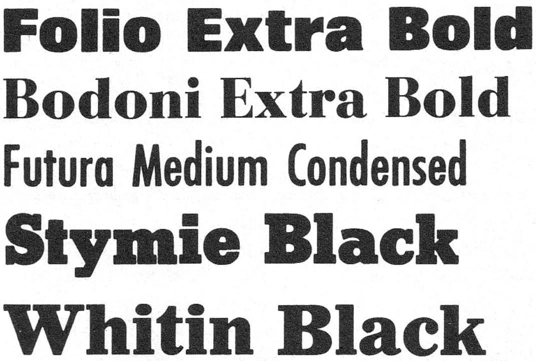
6 ABCDEFGHIJKLMNOPQRSTUVWXYZABCDEFGH
8 ABCDEFGHIJKLMNOPQRSTUVWXYZA
10 ABCDEFGHIJKLMNOPQRSTUV
12 ABCDEFGHIJKLMNOPQR
14 ABCDEFGHIJKLMNOP
18 ABCDEFGHIJKLM
24 ABCDEFGHI
30 ABCDEFG
42 ABCDE
48 ABCD
60 ABC

Figure 76. Point Size

ment with the expenditure needed to make the purchase.

Proofreaders Marks. A set of standard symbols or contractions developed to identify text errors, their correction, and typographic modifications on a proof in a clear concise manner. See Figure 77.

Profitability Index Method. In equipment replacement — the profitability index (PI). Known also as the present-worth method and the discounted cash flow method. A proposed equipment investment is evaluated by comparing the value of future income and cost savings from the invest-



Folio Extra Bold
Bodoni Extra Bold
Futura Medium Condensed
Stymie Black
Whitin Black

Figure 82. Type Face

PROOFREADERS MARKS

⊙	Insert Period
$\overset{\wedge}{,}$	Insert Comma
:	Insert Colon
;	Insert Semicolon
?	Insert Question Mark
!	Insert Exclamation Mark
=/	Insert Hyphen
$\overset{'}{\vee}$	Insert Apostrophe
$\overset{''}{\vee}\overset{''}{\vee}$	Insert Quotation Marks
$\frac{1}{N}$	Insert 1-en dash
$\frac{1}{M}$	Insert 1-em dash
#	Insert Space
ld >	Insert Lead
∨	Superior
∧	Inferior
(/)	Parentheses
[/]	Brackets
□	Indent 1 em
¶	Paragraph
no ¶	No Paragraph
tr	Transpose - used in margin
∿	Transpose - used in text
sp	Spell out
ital	Italic - used in margin
——	Italic - used in text
b.f.	Boldface - used in margin
〰	Boldface - used in text
s.c.	Small Caps - used in margin
═	Small Caps - used in text
rom.	Roman Type
caps.	Caps - used in margin
≡	Caps - used in text
c.+sc.	Caps and Small Caps - used in margin
≡	Caps and Small Caps - used in text
l.c.	Lower case - used in margin
w.f.	Wrong Font
⁐	Close up
ℯ	Delete
⁐ℯ	Close up and Delete
]	Move Right
[	Move Left
||	Align Vertically
=	Align Horizontally
stet.	Let it stand - used in margin
....	Let it stand - used in text
⊗	Dirty or broken letter
run over	Run over to next line - used in margin
⤶	Run over to next line - used in text
run back	Carry back to preceding line - used in margin
⤴	Carry back to preceding line - used in text
copy out	Something omitted—see copy
Qu.? (?)	Question to Author
∧	Caret—General indicator used to mark error in text
A.A.	Author's Alterations
P.E.	Printer's Errors

Figure 77. Proof Readers Marks

Proportionally Spaced Characters. Characters in a character set which have different widths according to the design characteristics of the letter or sign in question (i.e., W,M are wider than i, 1). This compares with Unispace characters normally found on a typewriter which allocate the same width to all characters irrespective of the design characteristic. The total number of variations of width depend on the system being considered. On a typewriter system with Proportionally Spaced Characters, a nine-unit system is employed which allows characters to allocate one of seven widths; 3, 4, 5, 6, 7, 8 or 9 units.

On a 36-unit phototypesetting machine any width from 0-36 may be allocated to any character. See Set Width.

Q

Quad. A large space usually qualified as an em quad which is equal to the point size by the set size; i.e., 12 points wide. See Spaces.

Quadding. The act of inserting quads; the generic term for quad left, right and center. See quad, quad left, quad right, and quad center.

Quad Center (Flush Center). A typographic instruction or description where text is displaced to the center of the normal measure. The interword spaces are not expanded for justification and therefore the deficit or remainder of space is divided equally for insertion on the left and right side of text. Where the deficit will not divide equally the remainder is placed on the right of text.

Quad, Left (Flush left). A typographic instruction or description where text is displaced to (flush) range with the left hand margin of text on the normal measure. The interword spaces are not expanded for justification and therefore the deficit or remainder of space is inserted to the right of the text.

Quad, Left (Right, Center Quadding; flush left, right, center). A typographic instruction or description where text is displaced to the left, right or center of a measure without the interword spaces being expanded for justification. The space deficit is inserted to the right or left of text or split equally to center text.

Quad Middle (Insert Blank). A typographic instruction or description where text is ranged left and right of the measure and the deficit or remainder of space is placed between the left hand and right hand text. The interword spaces in the text matter are not expanded to achieve justification. See Tabbing.

Quad, Right (Flush Right). A typographic instruction or description where text is displaced to range (flush) with the right hand margin of text on the normal measure. The interword spaces are not expanded for justification and therefore the deficit or remainder of space is inserted to the left of the text.

Quaint Characters. See Ligatures.

Qwerty Layout. A keyboard layout having the *q, w, e, r, t, y* keys in the top left-hand row of the alphabetic keys. The normal standard layout adopted for typewriters and many printing perforators. Opposed to the linecaster layout.

R

R & D. Research and development. A systematic and intensive study of a subject with a special purpose in mind such as: improvement of current products, development of new products and improved production methods.

Radix. Synonymous with base. In positional representation, that integer, if it exists, by which the significance of the digit place must be multiplied to give the significance of the next high digit place. In decimal notation, the radix of each place is ten.

Radix notation. A positional representation in which the significance of any two adjacent digit positions has an integral ratio called the radix of the less significant of the two positions.

Ragged Setting. Ragged setting is when a block of text is set using one interword space value. The line is justified to the measure by inserting the remaining space on the left or right of the text or splitting it equally and inserting it on the left and right of text. The effect is to have a ragged appearance or margin on at least one side.

Ragged Right. Text is set ranged or flush to the left hand margin, interword spaces are not expanded for justification and the deficit or remainder or space is placed on the right of the text to fill the line to the specified measure. The appearing text length will vary according to each line's content and will be ragged on the right hand margin.

Ragged Left. Text is set ranged or flush to the right hand margin, interword spaces are not expanded for justification and the deficit or remainder of space is placed on the left of the text to fill the line to the specified measure. The appearing text length will vary according to each line's content and will be ragged on the left hand margin.

Ragged Center. Text is set centered in the measure, interword spaces are not expanded for justification and the deficit or remainder of space is divided equally for insertion on the left and right hand side of the text. If the deficit when divided has a remainder this is inserted on the left of the text.

To avoid large variations in the text contained in each line, hyphenation can be used when setting ragged text.

On automatic systems (computers or typesetters with H & J) it is often possible to set a Justifying Zone. This is a point prior to the end of the line at which point the next interword space can terminate the line.

Rail. See Magazine.

Random Access. (1) The process of obtaining data from, or placing data into storage where the time required for such access is independent of the location of the data most recently obtained or placed in storage. (2) A storage device in which the access time is effectively independent of the location of the data.

Random Access Device. A device in which the access time is independent of the location of the data. Synonymous with direct access device.

Range. Synonymous with flush. See Flush Level. Predominantly a British term.

Real Time. (1) The actual time during which a physical process transpires. (2) The performance of a computation during the actual time that the related physical process transpires in order that computation results can be used in guiding the physical process.

Real Time Input. Input data which is inserted into a system at the time of generation by another system.

Real Time Output. Output data which is removed from a system at time of need by another system.

Recency. The state of being recent.

Recency Value. A quantity determined by several of the latest computer calculations.

Record Length. A measure of the size of a record, usually specified in units of words or characters, etc.

Record Separator. The information separator character which identifies a logical boundary between items called 'record'. Abbreviated RS.

Recording Density. The number of bits in a single linear track measured per unit of length of the recording medium.

Recto. The right-hand page of a job or work.

Reference Mark. Symbols, letters, or figures which direct the reader from the text to a footnote on the page, a group of footnotes at the end of chapter or section, or to a page or section of an index. The common marks are as follows:

(1) * Star or asterisk
(2) † Dagger
(3) ‡ Double-dagger
(4) § Section
(5) || Parallels
(6) ¶ Paragraph

Register. A device capable of storing a specified amount of data such as a word.

Relative Unit Space. See Spaces.

Retina. A lense and photocell array that allows an entire character to be viewed for recognition on an OCR.

Return. A TTS code 4 which, when used in conjunction with the Elevate Code 2, signifies the end of a line on paper tape-driven linecasters. The code still retains its name but can mean many things now.

Return on Invested Capital. A measure of the profitability and efficient use of capital. Expected yield or effective rate of return on an investment.

$$\text{rate of return} = \frac{\text{net income}}{\text{ave. invested capital}}$$

Reverse Leading. See Leading.

Roman. The normal upright characters or letters used in text. Based on the style of Roman inscriptions.

Routine. An ordered set of instructions that can have some general or frequent use.

RS. The abbreviation for the record separator character.

Rubout. When perforating paper tape, the traditional method of erasing an error is to backup the paper tape (reverse feed) and over punch every code position. The subsequent processing of text will ignore frames or characters with every hole punched.

Rule. The effect of a continuous line (s) or design (border) produced by placing multiple elements side by side so they visually overlap and join. See Dash.

Run Around. The ability to vary the length of text in a measure for a defined number of lines to leave space for an illustration or art work. In effect, an indention for a given number of lines is specified to commence at a defined point in text. The point at which the indention starts is always at the end of a line. This position in the text is often unknown until H & J commences and is simply defined as a given number of lines or points from the start position. Text can be run around to the left, right and center. Often, text in two adjacent columns will contain run arounds to coincide — to allow the required space for the illustration or artwork.

Run-In. An instruction that the indicated copy should immediately precede the subsequent text.

Running Head (Title). A heading or title in various styles that is repeated at the tops of pages.

S

Sale and Leaseback. The sale of property accompanied by the buyer's leasing the property back to the seller.

Salvage Value. An expected amount of money that will be realized when an asset is disposed of at the end of its useful life.

Scalar. A real number rather than a vector.

Sans Serif, (Type). Typeface designs in which the letters do not have serifs.

Section Mark. The fourth footnote reference mark. (§)

Serial Access. (1) The sequential or consecutive transmission of data to or from storage. (2) The process of obtaining data from, or placing data into storage where the time required for such access is dependent upon the location of the data most recently obtained or placed in storage. Contrast with random access.

Serial Computer. (1) A computer which has a single arithmetic and logic unit. (2) A computer, with some specified characteristic which is serial; e.g., a computer that manipulates all bits of a word serially. Contrast with parallel computer.

Serial Operation. The sequential or consecutive execution of two or more operations in a single device such as an arithmetic or logic unit. Contrast with parallel operation. Only one operation can be performed at one time followed by the next operation.

Serial Processing. The sequential or consecutive execution of two or more processes in a single device such as a channel or processing unit. Contrast with parallel processing.

Serial Transmission. In telecommunications, transmission of successive intervals of signal elements constituting the same data signal. The sequential elements may be transmitted with or without interruption, provided that they are not transmitted simultaneously. For example; telegraph transmission by a time-divided channel. Contrast with parallel transmission.

Serif. The short strokes that project from the principal strokes (or lines) of characters.

Set Size. The term applies to the horizontal dimension of typeface. The vertical depth is specified in points and the horizontal width in 'set'.

Set is equal to one point; 8 set is equal to 8 points.

Usually the typeface design is based on the square of the point size. A 10 point type face is 10 set. The em of the typeface is 10 points high by 10 points wide. The em is divided vertically into a number of units. Usually either 18 or 36 subdivisions to the em. Two units of a 36 unit system are equal in absolute value to one unit of an 18 unit system. The 36 unit system is often referred to as a 'half unit system' as increments one half the value of an 18 unit system can be obtained. If the set size is increased to 10½ set the em is 10 points high by 10½ points wide. One unit of 10 set on an 18 unit system is therefore less than one unit of 10½ set on an 18 unit system.

1. Set size is the horizontal dimension of space allocated to a typeface. See Figure 79.

2. If not qualified, it is assumed that the em is the square of the pointsize, i.e., 10 point Times has an em 10 points high by 10 points wide.

3. Set = 1 point = 0.01383
10½ set = 10½ points = 0.1452
12 set = 12 points = 0.1659 (One Pica)

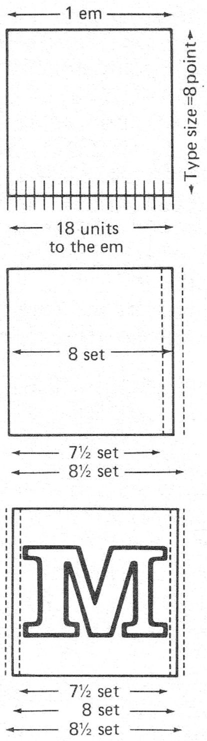
4. Set and point size specifically relate to the space allocated to characters and does not in any way indicate the absolute dimensions of the character design or image which 'fits' the space allocated. See Image.

5. Unit of Set. Each em can be subdivided into a number of units (usually 18 or 36 whose absolute value is:

$$\frac{\text{Set Size} \times \text{Point Value} \times \text{Number of Units of set}}{\text{Number of units in EM}}$$

8 units of 10 point 10½ set on an 18 units counting system is:

Figure 78. Set Width



This is the way a Monotype face looks set 8 on 10 point at 8½ set. Note how the inter-character space has been reduced by a small amount.

This is the way a Monotype face looks set 8 on 10 point at normal 8¾ set. Note how the inter-character space is more open than the example above.

This is the way a Monotype face looks set 8 on 10 point at 9½ set. Note how the inter-character space has been increased.

Decreasing set decreases white space between characters.
Increasing set adds white space between characters.

$$\frac{10.5 \times 0.01383 \times 8}{18} = 0.06454''$$

Secondary Line Length. See Measure.

Set Solid. A block of text set with no extra leading between the lines. The amount of vertical space measured from baseline to baseline equals the amount of space allocated to the point size that the characters occupy.

Shank. See Type.

Shift, (Unshift codes). A method of increasing the code combinations obtainable from a given number of codes. With six-level TTS coding, 64 discrete codes are possible. By allocating two positions to shift and unshift the remaining 62 codes have one of two “meanings” depending on the preceding shift code. The total combination of codes available is increased to 124. Normally capital characters are in the shift position and lower characters in the unshift position; Hence, shift and unshift characters. Super Shift is a further code (or codes) used to extend the available code combinations. Invariably the more shifts available, the more complex the keyboarding when accessing the full flexibility of the system. Synonymous with Escape Character.

Shilling Mark, (Stroke) See Solidus. (/)

SI. The abbreviation for the shift-in character.

Skew. The ability to indent text a varying amount over a specified depth (number of lines). The process can be manual or by computer typography program. The program changes the amount of indent given each increment for each line. The increment value of indent change is normally calculated by the program from the maximum and minimum line lengths and the number of lines.
e.g.: maximum line length - minimum line length/depth = total indent value /number of lines = incremental indent/line

Reverse Skew Center (Both). The ability to specify a decreasing left and right indent for a specified depth. The incremental value of the decreasing indent to be specified or automatically calculated as above.

In facsimile transmission, skew is the deviation from a rectangular shaped picture (frame) caused by the lack of time coincidence between the scanner and the recorder.

Reverse Skew Left. The ability to specify a decreasing left indent for a specified depth. The incremental value of the decreasing indent to be specified or automatically calculated as above.

Reverse Skew Right. The ability to specify a decreasing right indent for a specified depth. The incremental value of the decreasing indent to be specified or automatically calculated as above.

Skew Center (Both). The ability to specify an increasing left and right indent for a specified depth. The incremental value of the increasing indent to be specified or automatically calculated as above.

Skew Left. The ability to specify an increasing left indent for a specified depth. The incremental value of the increasing indent to be specified or automatically calculated as above.

Skew Right. The ability to specify an increasing right indent for a specified depth. The incremental value of the increasing indent to be specified or automatically calculated as above.

Side Bearings. The name given to the space allocated either side of a character image which normally prevents its overlapping the preceding and succeeding characters in a line. The space is in addition to the furthest point reached by the character design in both horizontal directions. The sum of the character image width and the side bearings is equal to the set width.

Small Caps, (Capitals). A design of capital characters with a height normally equal to the "x" height of the lower case letter.

Software. (1) A set of computer programs, procedures, rules, and possibly associated documentation concerned with the operation of a data processing system; e.g., compilers, library routines, manuals, circuit diagrams. (2) Contrast with hardware.

Solid State Component. A component whose operation depends solely on the control of electric or magnetic phenomena in solids, e.g., a transistor, crystal diode, ferrite core.

Solidus. A typographic sign (/) variously referred to as a diagonal, a shilling stroke, slash, or virgule. A diagonal line used to manufacture fractions (⅞) or separate text.

Sort. A specific character or matrix identitied in a character set or from pi characters.

Source Language. The language from which a statement can be translated.

SP. The abbreviation of the Space Character.

Spaces. Spacing used in composition can be separated into two main categories.

a. Horizontal Spacing
b. Vertical Spacing

Horizontal Spacing is used to achieve justification and present the text in the line as clearly as possible to the reader and/or achieve the typographic effect required. The principal categories of horizontal spacing are Variable Space, Relative Space and Fixed Space. Other spacing units or variations are letterspacing (See Letterspacing), kerning (See Kerning) and sidebearings (See Type Nomenclature).

1. *Variable Space.* referred to variously as:

Word Space,
Interword Space,
Nominal Interword Space,
Nominal Interword Variable Space,
Interword Variable Space,
Space Band.

In all cases the variable space, whatever it is called, performs the same function. It is a code normally spaced between words which will activate the typesetter and produce a non-printing character or space. The code is treated as a space and is allocated a nominal width, normally 4 units (on an 18-unit system). When a line is justified, the additional amount of space calculated to be necessary to achieve justification will be added to each occurrence of the variable space code in the line. The variable space code, therefore, has a nominal value prior to processing and then on processing is combined with an amount which varies according to the requirements of justification. The variable spaces in the line will be treated equally irrespective of their location in text (although usually these spaces will occur between words). The resultant value of the space which occurs in a line between words varies, thus, the multitude of terms indicated at the beginning of this section. The important point is that the precise value of each space between words is not known until the justification process takes place and is calculated. Therefore, the space between words is variable.

2. *Relative Space.* Often referred to as fixed spaces. A relative space is of a fixed value relative to the set size of typeface in question. Common Relative Spaces are:

18 units	Em Space (Mutton Quad)
9 units	En Space
6 units	Thick
4.5 units	Middle
3.6 units	Thin

All unit values are based on an 18 unit system. Multiply by 2 for the 36 unit or half-unit system. Although the unit value of space is 'fixed' for the above in terms of units, the absolute value will change according to the set size. Its absolute value is therefore always related or relative to the set size.

10 point (therefore 10 set) EM Space = $10 \times .01383/18 \times 18 = 0.1383''$

12 point (therefore 12 set) EM Space = $12 \times .01383/18 \times 18 = 0.1659''$

3. *Fixed Space.* A true fixed space has a value which is unchanged irrespective of point size change or set size change. Its base unit can be any convenient dimension: Millimeters, Inches, Picas, Points.

By definition a fixed space is always expressed in base or absolute units.

Vertical Spacing. Vertical spacing is achieved by physically moving the end product past the exposure point or by defecting characters from the normal exposure path. The first method is referred to as leading and the second is called Base Line Deflection. See Leading and Baseline Deflection.

Space, Figure. The inclusion of a space value equal to the space value allocated to figures in a particular typeface. Some systems will access a figure location, utilize the width, but automatically suppress the exposure of the character. The figure space is used in tabular, numeric work and allows alignment of numerals.

Space, Hair. See Hair Space.

Space Band. The TTS code 3 which when used in conjunction with paper tape driven linecasters indicates an interword space. Now used frequently to mean an interword space, but it can, on occasions, represent some other functions as well.

Spanish Ñ. The letter ñ with the tilde (ñ), giving it a sound as though followed by the letter y, i.e., the first n in cañon; pronounced canyon.

Sprocket Feed. The holes in paper tape, one for each frame or character — diameter smaller than the data holes used by paper tape readers and punches for feeding the paper tape. Usually the sprocket hole is on the same 'line' as the data holes and is referred to as centered sprocket hole. The alternative system is Advanced Sprocket Hole used by TTS equipment where the sprocket hole is aligned with the leading edge of the data holes.

Start of Heading Character. A communication control character used as the first character of a heading of a message. Abbreviated SCH.

Start of Text Character. A communication control character used to indicate the start of a text, and to terminate a heading. Abbreviated STX.

State of the Art. That which can, without further research and development, be accomplished with technology that has been proven in practice. That which can currently be made.

Store. (1) A device into which data can be entered, in which it can be held, and from which it can be retrieved at a later time. (2) Loosely, any device that can store data. (3) Synonymous with memory. (4) For example, auxiliary storage, capacitor storage, cathode ray tube storage, circulating storage, content addressed storage, dynamic storage, electrostatic storage, mercury storage, nonerasable storage, parallel search storage, parallel storage, permanent storage, read-only storage, static storage, temporary storage, volatile storage, working storage.

Storage Device. A device into which data can be inserted, in which it can be retained, and from which it can be retrieved.

Strike On. A process of setting type by direct impression such as the output of a typewriter composing device.

String. A linear sequence of entities such as character or physical elements.

String Explosion. See Format.

Straight Matter (Straight-Text). Text set to one measure with only one point size and one typeface (includes Roman, Bold, Italic, etc.).

Style. A system or rule of uniformity used by printers to secure consistency of capitalization, punctuation and spelling.

Style, House. The style set or adopted by a printer or publisher.

Sub Head (Cross Head). A heading or caption placed under main heading or divisions of a job. A supplemental heading in straight text.

Sub Title (Bastard Title, Half Title). A secondary or subordinate title or the main title repeated in a subordinate position.

Subroutine. (1) A routine that can be part of another routine. (2) See Closed Subroutine, Direct Insert Subroutine, Open Subroutine.

Subscript. See Inferiors.

Supershift. A code which changes the meaning (different from normal) of subsequent codes. Abnormal meaning is valid until cancelled.

Supervisory Routine. The coordinating, directing, or modifying routine that controls the operations of other routines (programs). The same as executive routine.

Sub-Set. A group of characters or codes which form a part of a larger group.

Superior. A letter or figure (5,a) of a small face appearing at the top of a line of type, used as a reference mark.

Superscripts (Superiors). A symbol (letter) written above a set name to provide unique identification.

T

Table. The arrangement of text in more than one column. Composition involving columns of type with vertical and horizontal rules. A collection of data in which each item is uniquely identified by a label, by its position relative to the other items, or by some other means.

Table Look-up. A procedure for obtaining the function value corresponding to an argument from a table of function values.

Tabbing (Tab.). Is the same function as quadding that occurs in a line but occurs specifically in column. The function of tabbing displaces the text in the line of the column but does not affect the text in other columns and does not terminate the line or advance to the next column. Tabbing instructions allow text to be displaced to the left, right and center of the column width. See Quad.

Take. A 'unit' of text. Normally the amount convenient for one perforator operator to produce in one operation; one portion of text on paper tape, a portion of text convenient for a compositor to handle.

Teletypesetting. (TTS), a method of operating a linecaster using punched paper tape. The coding structure is referred to as TTS coding and based on 6-level tape. (Teletypesetter is the registered trademark of the Fairchild Corporation.)

Tape Drive. A device that moves tape past a head. Synonymous with tape transport.

Target Program. Same as Object Program

Text. The main body of matter, as distinct from headings or footnotes.

Thin Space. See Spaces. 1/5 of an em Space.

Tilde. See Accent.

Time Share. To use a device for two or more interleaved purposes.

Track. (1) The portion of a moving storage medium, such as a drum, tape, or disk, that is accessible to a specified reading head position. See Clock Track.

Type Design. The artistic aspects of a typeface. See Figure 80.

Type Nomenclature. Is based on established terms which originated for hand cast and mechanical cast hot metal type.

1. Face
2. Counter
3. Bevel
4. Shoulder
5. Beard
6. Serifs
7. Crossbar
8. Belly
9. Back
10. Body
11. Set Size
12. Point Size
13. Nick
14. Groove
15. Feet
16. Side Bearing

See Figure 79.

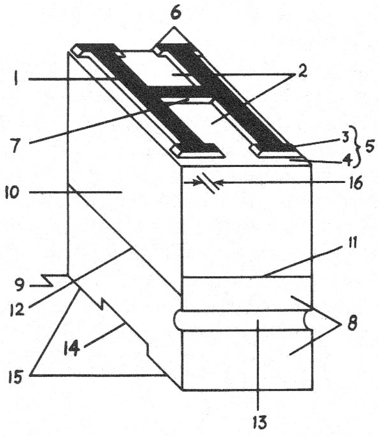


Figure 79. Type Nonclementure

Type Size. See Point Size.

Typeface. The generic name of a family or series of type designs based on a common theme. i.e., Baskerville, Times, Plantin, Royal.

Typesetting. Setting of type by one or four processes: hot type, cold type, etch type, or strike on.

Typestyle,. The variations or styles within a typeface. i.e., Roman, Italic, Bold, Bold Italic, Condensed, Expanded. See Figure 81.

Point Size. Refers to the vertical and normally the horizontal distance of the characters. 6 point, 12 point, etc.

Font. A font is a defined *style* from a particular *face* in a defined size. i.e., 6 point Times Roman

Typeface design is evolutionary and several methods of classification have been developed. A type classification refers to a group of typefaces with similar characteristics or basis of design.i.e., Modern, Old Style, Transitional. See Figure 83.

Typography. The style, arrangement, design or appearance of printed matter or appearance of printed matter or elements composed within the printed matter.

U

Unit Count Font. Each character in a character set has a defined width irrespective of the type face or style. Within a character set the widths are different depending on the requirement of the design.

Unitized Font. Any character in a character set in any size face or style has its own width and is independent of all other characters with regard to them.

Upper Case. Capital letters or majuscules of a character set. Abbreviated Caps, i.e., *A B C D*

USASCII (USA Standard Code for Information Interchange). The standard code, using a coded character set consisting of 7-bit coded characters (8 bits including parity check.) Used for information interchange among data processing communication systems, and associated equipment. The USASCII set consists of control characters and graphic characters. Synonymous with ASCII.

V

Variable-Length Record. A file in which the record length is not constrained.

Variable Space. See Spaces.

Vector. A line denoting magnitude and direction. Contrast with scalar.

Vectoring. Instructing a program to go to a given location to locate additional instructions.

Vectoring an Interrupt. An instruction which tells the computer to proceed to a given memory location when a particular input/output interrupt occurs.

Verso. The left hand page of a book or work.

Vertical Justification. The spacing of text in a column or page to fit a defined space by increasing or decreasing the interline spacing or manipulating the text so that it fits the defined area. Almost the same procedure that occurs for justifying a line in the horizontal direction except that the definition of blocks is lines, paragraphs, etc. instead of character, words, etc.

Vertical Rule. A rule or continuous line or design which encompasses a defined length in the vertical direction.

Virgule. See Solidus.

W

White Space Reduction. See Kerning.

Widow. A short line at the top of a page or column.

Width Value. A list or group of widths assigned to a character set.

Word. A character word, numeric word, alphabetic word, machine word.

Word Length. A measure of the size of a word, usually specified in units such as characters or binary digits.

Word Processing. Entry, editing, and storage of words utilizing a hardcopy typewriter and magnetic storage systems.

Word Space. See Spaces.

Word Time. In a storage device that provides serial access to storage locations, the time interval between the appearance of corresponding parts of successive words.

Working Storage. Same as temporary storage.

Write. To record data in a storage device or a data medium. The recording need not be permanent, such as on a cathode ray tube display device.

Write off. To transfer assets to an expense account or to the profit and loss account as a loss.

Wrong Font (W.F.). A type character of a style or size different from that being used for the text being surveyed.

X

x - Height (z Height). The term applied when describing the vertical dimension of lower case characters in a type face.

Xenon Flash. The light source of discharge tubes often used in phototypesetting machines. The characteristic is high intensity, short exposure and the light output predominatly in the blue end of the spectrum.

Z

Zero Lead. See Lead.
Zero Set. See Set.

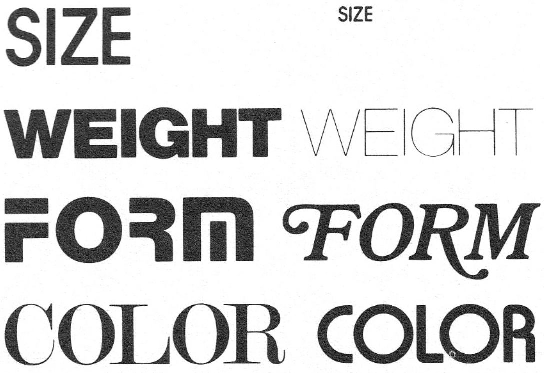

SIZE
SIZE
WEIGHT
WEIGHT
FORM
FORM
COLOR
COLOR

Figure 80. Type Design

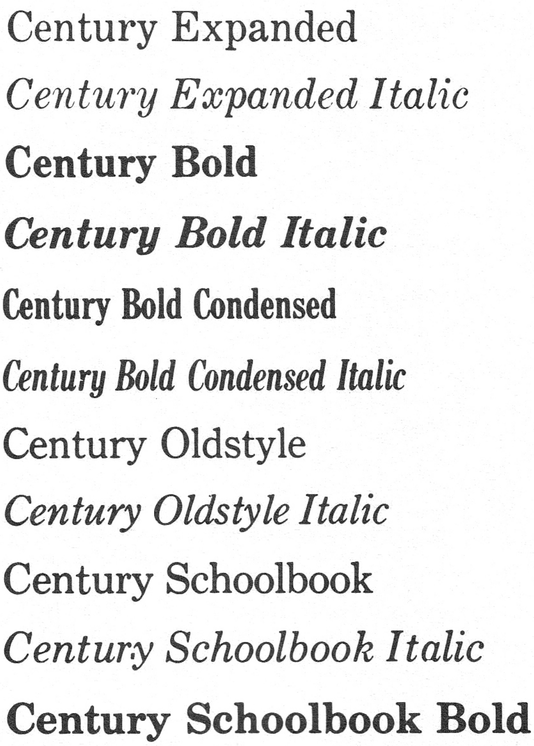

Century Expanded
Century Expanded Italic
Century Bold
Century Bold Italic
Century Bold Condensed
Century Bold Condensed Italic
Century Oldstyle
Century Oldstyle Italic
Century Schoolbook
Century Schoolbook Italic
Century Schoolbook Bold

Figure 81. Type Style

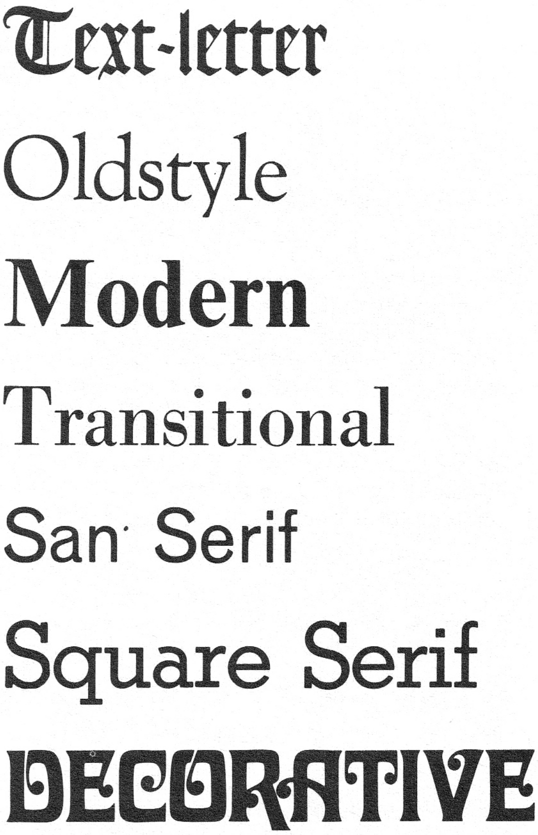

Text-letter
Oldstyle
Modern
Transitional
San Serif
Square Serif
DECORATIVE

Figure 83. Type Face Classification

Selected List of References

For the reader's convenience there is presented here a list of books which is by no means complete, but may be helpful in the further study of lithography and its related fields. The list was prepared by N. Edward Berg and the staff of the Technical Information Division of the Graphic Arts Technical Foundation's E. H. Wadewitz Memorial Library. This library is probably the most comprehensive source of scientific, technical, and educational information on graphic communications and related subjects to be found anywhere in the western hemisphere. Every effort is made to keep the library up-to-date through constant direct contact with publishers, and through the review of the publishers' trade lists.

Allen, Edward Monington, ed. *Harper's Dictionary of the Graphic Arts. New York: Harper & Row, 1963.*

Arnold, Edmund C. *Functional Newspaper Design.* New York: Harper & Row, 1956.

—— *Ink on Paper.* New York: Harper & Row, 1963.

Banks, W. H., ed. *Advances in Printing Science.* Volume I, *Printing Inks and Color.* Volume III, *Halftone Printing.* New York: Pergamon Press, 1961, 1963.

Barnett, Michael P. *Computer Typesetting: Experiments and Prospects.* Cambridge, Massachusetts: M.I.T. Press, 1965.

Biegeleisen, J. I. *The Complete Book of Silk Screen Printing Production.* New York: Dover Publications, 1963.

Billmeyer, Fred W., Jr. and Stazman, Max. *Principles of Color Technology.* New York: Interscience Publishers, 1966.

Brookes, B. C., ed. *Editorial Practices in Libraries.* London: Aslib, 1961.

Bruno, Michael H. *Pocket Pal,* 11th ed. New York: International Paper Co., 1974.

Burt, Cyril. *A Psychological Study of Typography.* Cambridge, England: Cambridge University Press, 1959.

Campbell, Edward A. *Safety Manual for the Graphic Arts Industry.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1972.

Carroll, John S., ed. *Photo-Lab-Index.* Hastings-on-Hudson, New York: Morgan & Morgan, 1965.

Cartwright, H. M. *Ilford Graphic Arts Manual.* Volume I, *Photo-Engraving.* Essex, England: Ilford Limited, 1961.

Cleeton, Glen U. and Pitkin, Charles W. *General Printing.* Bloomington, Illinois: McKnight & McKnight Publishing, 1963.

Cogoli, John E. *Photo-Offset Fundamentals.* 2nd ed. Bloomington, Illinois: McKnight & McKnight Publishing, 1973.

Composition Information Services. *Glossary of Automated Typesetting and Related Computer Terms.* Los Angeles: Composition Information Services, 1966.

Flexographic Technical Association. *Flexography: Principles and Practices.* New York: Flexographic Technical Association, 1962.

Gerber, Jack. *A Selected Bibliography of the Graphic Arts.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1967.

Halpern, Bernard R. *Color Stripping.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1955.

—— *Offset Stripping – Black and White.* Pittsburgh: Graphic Arts Technical Foundation, 1958.

Hartsuch, Paul J. *Chemistry of Lithography.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1961.

Hattery, Lowell H. and Bush, George P., eds. *Automation and Electronics in Publishing.* Washington, D.C.: Spartan Books, 1965.

Hurst, C. A. and Lawrence, F. R. *Letterpress Composition and Machine Work.* London: Ernest Benn Ltd., 1963.

Hutchings, R. S. and Skilton, Charles, eds. *Modern Letterpress Printing: Materials and Methods in the Machine Room.* London: Charles Skilton, Ltd., 1963.

Jaffe, Erwin. *Halftone Photography for Offset Lithography.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1960.

—— *Contact Printing.* Pittsburgh, Graphic Arts Technical Foundation, 1964.

—— and Reed, Robert F. *The Science of Physics.* Pittsburgh: Graphic Arts Technical Foundation, 1964.

James, T. H., ed. *The theory of the Photographic Process.* New York: Macmillan Company, 1966.

Jorgensen, George W. *Lithographic Pressman's Handbook.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1973.

—— and Bruno, Michael H. *The Sensitivity Guide.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1959.

Karch, R. Randolph. *How to Recognize Type Faces.* Bloomington, Illinois: McKnight & McKnight, 1952.

—— and Buber, Edward J. *Graphic Arts Procedures: The Offset Processes.* Chicago: American Technical Society, 1967.

Kenneison, W. C. and Spilman, A. J. B. *Dictionary of Printing, Papermaking and Bookbinding.* London: George Newnes Limited, 1963.

Kosar, Jaromir.. *Light-Sensitive Systems: Chemistry and Applications of Non-Silver Halide Photographic Processes.* New York: John Wiley & Sons, 1965.

Kosloff, Albert. *Photographic Screen Process Printing.* Cincinnati, Ohio: Signs of the Times Publishing, 1965.

Lasday, Stanley B. *Handbook for Graphic Communications.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1972.

Lasky, Joseph. *Proofreading and Copy Preparation: A Textbook for the Graphic Arts Industry.* New York: Mentor Press, 1964.

Latham, Charles W. *Advanced Pressmanship – Sheetfed Presses.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1963.

—— *Offset Lithographic Press Operating – Sheetfed Presses.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1963.

—— and White, Jack. *Photocomposing.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1964.

Leith, Robert M. and Owczarski, Louise M. *Glossary of Typographic Terms.* Washington, D.C.: International Typographic Composition Association, 1974.

Levenson, Harvey R. and others. *Art and Copy Preparation with an Introduction to Photo-*

typesetting. Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1974.

MacKay, Robert and Cartwright, H. M. *Rotogravure: A Survey of European and American Methods.* Lyndon, Kentucky: MacKay Publishing Co., 1956.

Messner, Richard. *Selling Printing and Direct Advertising.* New York: Fred W. Hoch Associates, 1974.

Neblette, C. B. and Murry, Allen E. *Photographic Lenses.* Hastings-on-Hudson, New York: Morgan & Morgan, 1965.

Noemer, Ewald Fred. *The Handbook of Modern Halftone Photography.* Damarest, New Jersey: Perfect Graphic Arts, 1965.

Phillips, Arthur. *Computer Peripherals and Typesetting.* London: Her Majesty's Stationery Office, 1968.

PIA (Printing Industries of America). *A Composition Manual.* Washington, D.C.: Printing Industries of America, 1953.

Purves, Frederick and others. *The Focal Encyclopedia of Photography.* New York, Macmillan Company, 1956.

Radford, R. G. *Letterpress Machine Work.* London: Staple Press, Ltd., 1957.

Ratliff, Floyd. *Mach Bands: Quantitative Studies on Neural Networks in the Retina.* San Francisco: Holden-Day, 1965.

Reed, Robert F. *What the Lithographer Should Know About Paper.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1959.

——*What the Lithographer Should Know About Ink.* Pittsburgh: Graphic Arts Technical Foundation, 1962.

——*Offset Press Troubles – Sheetfed Presses.* Pittsburgh: Graphic Arts Technical Foundation, 1962.

——*Instruments for Quality Control.* Pittsburgh: Graphic Arts Technical Foundation, 1963.

——*Web Offset Press Troubles.* Pittsburgh: Graphic Arts Technical Foundation, 1966.

——*Offset Lithographic Platemaking.* Pittsburgh: Graphic Arts Technical Foundation, 1967.

Robinson, Karl Davis. *Line Photography for the Lithographic Process.* Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1956.

Rockefeller, John W. *Money in Printing.* Denville, New Jersey: Modern Lithography, 1968.

Rodriguez, Cesar and Humphrey, George H., eds. *Bilingual Dictionary of the Graphic Arts (English-Spanish; Spanish-English).* Farmingdale, New York: George H. Humphrey, 1966.

Romano, Frank J. *Photocomposition and You.* Salem, New Hampshire: Graphic Arts Marketing Associates, 1974.

——*Automated Typesetting: The Basic Course.* Salem, New Hampshire: Graphic Arts Marketing Associates, 1974.

Roy, Robert H. *Management of Printing Production.* Washington, D.C.: Printing Industries of America, 1953.

Seybold, John W. *The Primer for Computer Composition.* Arlington, Virginia: Graphic Communications Computer Association, 1971.

Shapiro, Charles, ed. *The Lithographers Manual,* 5th ed. Pittsburgh, Pennsylvania: Graphic Arts Technical Foundation, 1974.

Steffens, Robert N. *Engraved Stationery Handbook.* New York: The Cronite Press, 1950.

Strauss, Victor. *The Printing Industry. Washington, D.C.: Printing Industries of America, 1967.*

Tinker, Miles A. *Legibility of Print.* Ames, Iowa: Iowa State University Press, 1963.

U.S. Government Printing Office. *Theory and Practice of Bookbinding.* Washington, D.C., 1962.

——*Theory and Practice of Presswork.* Washington, D.C., 1962.

—— *Typography and Design.* Washington, D.C., 1963.

University of Chicago, Editorial Staff. *A Manual of Style.* Chicago: University of Chicago Press, 1974.

Updike, Daniel Berkely. *Printing Types: Their History, Forms and Use.* Cambridge, Massachusetts: Harvard Universtiy Press, 1963.

—— *A Study in Survivals.* Cambridge, Massachusetts: Harvard University Press, 1963.

Selected List of Periodicals

The E. H. Wadewitz Memorial Library at GATF receives over 220 periodicals. Each of these periodicals is examined for articles of interest which are then summarized, or "abstracted" for ready reference. These abstracts are classified and filed as an index to the information contained in the articles. This file is probably unexcelled anywhere; entries now number over 70,000, and over 3,500 are added per year.

A selection of these abstracts — the most significant ones — is assembled and published under the title *Graphic Arts Abstracts*. This publication is sent to GATF members each month, free of charge. Others may subscribe to the *Abstracts* for a small fee. On request, the published abstracts are made available to the trade press. Interested readers, if they cannot get the periodical directly, may write to GATF to obtain a photocopy of any article that interests them. A 'break-even' charge is made for the photocopy service.

The following periodicals are some of those abstracted by GATF's Library staff.

Administrative Management. Geyer-McAllister, 212 Fifth Avenue, New York, New York 10010

American Paper Merchant. Peacock Business Forms, 200 S. Prospect Avenue, Park Ridge, Illinois 60068

ANPA/RI Bulletin. 750 Third Avenue, New York, New York 10017

Art Direction. Advertising Trade Publications, 19 W. 44th Street, New York, New York 10036

Artes Graficas. Graphic Art Trade Journals International, 341 Conklin Street, Farmingdale, Long Island, New York 11735

Asian Printer. Insatsu Gakkai, Shuppanbu 4, Ginza 5, Chuo-ku, Tokyo, Japan

Australian Lithographer. 170 Kurraba Road, Neutral Bay, New South Wales, Australia

Book Production Industry. P.O. Box 696, 125 Elm Street, New Canaan, Connecticut 06840

British Printer. Maclean-Hunter Ltd., 30 Old Burlington Street, London, England

Bulletin of the Technical Association Graphic Arts Japan. Nippon Insatsu Gakkai, No. 23, Shintomicho-2, Chuo-ku, Tokyo, Japan

Business Forms Reporter. North American Publishing Co., 134 N. 13th Street, Philadelphia, Pennsylvania 19107

Business Graphics. Graphic Arts Publishing

Company, 7373 N. Lincoln Avenue, Chicago, Illinois 60646

Cahiers de Documentation. IPREIG, 17 Rue des Reculettes, Paris 13, France

Canadian Printer & Publisher. Maclean-Hunter Publishing Company Ltd., 481 University Avenue, Toronto 2, Canada

Caractère. Compagnie Francaise d' Editions, 40 Rue du Colisée, Paris 8, France

Computer Program Abstacts. Superintendent of Documents, Government Printing Office, Washington, D.C. 20402

Computerworld. 797 Washington Street, Newton, Massachusetts 02160

DA. Paper Makers' Advertising Association. 90 Elm Street, Westfield, Massachusetts 01085

Data Processor. IBM Data Processing Division, 112 E. Post Road, White Plains, New York 10601

Datamation. P.O. Box 2000, Greenwich, Connecticut 06830

Deutscher Drucker. Verlag Gesellschaft GmbH, 7000 Stuttgart W., Forstrasse 60, Postfach 2650, West Germany

Documentation Bibliographique. Centre de Liaisons Techniques, Lorilleux-Lefranc S.A., 4 bis, Rue Bernard Palissy, Puteaux, France

Druck Print. P. Keppler Verlag KG, 6056 Heusenstamm, Industriestrasse 2, West Germany

Drukkerswereld. Van Eeghenstraat 70, Postbus 5453, Amsterdam, Netherlands

Editor and Publisher. 850 Third Avenue, New York, New York 10022

Export Polygraph International. Polygraph Verlag GmbH, Frankfurt-am-Main, Schaumainkai 85, West Germany

Fachhefte Bulletin Technique. Conzett & Huber, Zurich 4, Morgartenstrasse 29, Switzerland

Farbe, Die. Musterschmidt-Verlag, Gottingen, Turmstrasse 7, West Germany

Finnish Pulp & Paper Research Institute Publications. Finnish Pulp & Paper Research Institute, Helsinki, Finland

Focus. Bausch & Lomb Optical Company, Rochester, New York 14602

FOGRA Institutsmitteilungen. Deutsche Gesellschaft fur Forschung im Graphischen Gewerbe, Bamberger Haus im Luitpoldpark, Munchen 13, West Germany

FOGRA Literaturdienst. Same address.

FOGRA Mitteilungen. Same address.

FOGRA Praxis Report. Same address.

Form. National Business Forms, 300 N. Lee Street, Alexandria, Virginia 22314

GRAC Newsletter. Graphic Arts Research Center, Rochester Institute of Technology, One Lomb Memorial Drive, Rochester, New York 14623

Going Metric. Metrication Board, 22 Kingsway, London WC2B 6LE England

Grafika. P.O. Box 919, Makati Commercial Center, Makati, Rizal, Philippines

Grafische Technik. Abtlg. Dokumentation, Inselstrabe 20, Leipzig C1, East Germany

Grafiska Forskningslaboratoriet Meddelands. Grafiska Forskningslaboratoriet, Stockholm, Sweden

Graphic Arts Bulletin. Customer Services Department, Mead Papers, Chillicothe, Ohio 45601

Graphic Arts Buyer. Advertising Trade Publications, 19 W. 44th Street, New York, New York 10036

Graphic Arts in Finland. Graafisen Tekniikan Tutkimussaatio, Juolukkatie 3, SF-02150 Otaniemi, Finland

Graphic Arts Japan. Japan Printers Association, 23, 2-Chome, Shintomi-cho, Chuo-ku, Tokyo, Japan

Graphic Arts Literature Abstracts. Rochester Institute of Technology, One Lomb Memorial Drive, Rochester, New York 14623

Graphic Arts Monthly. Graphic Arts Publishing Company, 7373 N. Lincoln Avenue, Chicago, Illinois 60646

Graphic Arts Register. Du Pont Photo Products Department, Wilmington, Delaware 19898

Graphic Arts Unionist. Lithographers and Photoengravers International Union, 233 W. 49th Street, New York, New York 10019

Graphic Communications Weekly. Technical Information, Inc., P.O. Box 775, South Lake Tahoe, California 95705

Graphics: New York. Kaye Publishing Corporation, 535 Fifth Avnue, New York, New York 10017

Gravure Technical Association Bulletin. GTA, Incorporated, Suite 858, 60 E. 42d Street, New York, New York 10017

GRI Newsletter. Gravure Research Institute, 22 Manhasset Avenue, Port Washington, New York 11050

Heidelberg News. Schnellpressenfabrik AG, Heidelberg Eastern, Inc., 73-45 Woodhaven Boulevard, Glendale, Long Island, New York 11227

IGT Nieuws. Stichting IGT, Ter Gouwstraat 1, Amsterdam, Netherlands, Postbus 4150

IGTechniek. Instituut voor Graphische Techniek, T.N.O., Ter Gouwstraat 1, Amsterdam, Netherlands

Imaging News. SPSE, 1330 Massachusetts Avenue N.W., Washington, D.C. 20005

IMC Journal. 13388 Hammons Avenue, Saratoga, California 95070

Imprimerie Nouvelle. 20 Rue Danielle-Casanova, Paris 2, France

IFRA Newspaper Techniques. Washingtonplatz 1, 61 Darmstadt, West Germany

Indicatore Cartotecnico. 001818 Roma, Via Assisi 163, Italy

Indicatore Grafico. Same address.

Information and Records Management. 250 Fulton Avenue, Hempstead, Long Island, New York 11550

Inland Printer/American Lithographer. Maclean-Hunter Publications, 300 W. Adams Street, Chicago, Illinois 60606

In-Plant Printer. United Business Publications, 200 Madison Avenue, New York New York 10016

Interfaces. Institute of Management Sciences, in cooperations with Operations Research Society of America, 146 Westminster Street, Providence, Rhode Island 02903

International Photo-Technik. Verlag Grossbild Technik, 45 Rupert Mayer Strasse 8, München 25, West Germany

Inter-Society Color Council Newsletter. Photographic Technology Division, Building 65, Eastman Kodak Company, Rochester, New York 14650

Journal of Micrographics. National Microfilm Association, 8728 Colesville Road, Silver Spring, Maryland 20910

Kodak Bulletin for the Graphic Arts. Graphic Arts Publications, Eastman Kodak Company, Rochester, New York 14650

Kodak Studio Light. Same address.

Lithopinion. Amalgamated Lithographers of America, 113 University Place, New York, New York 10003

Lithoprinter. Gillow House, 5 Winsley Street, London W1A 2HG, England

Maitre Imprimeur, Le. Association des Maitres Imprimeurs de Montreal, 480 E. Mont Royal Avenue, ch 22, Montreal, Quebec, Canada

M.A.N. Printing Machinery News. M.A.N. Maschinenfabrik, Augsburg-Nurnberg, 8900 Augsburg, West Germany

Micro-News Bulletin. National Microfilm Association, P.O. Box 386, Annapolis, Maryland 21404

Microfilm Techniques. 250 Fulton Avenue, Hempstead, Long Island, New York 11550

Midwest Graphics Industry. 2617 E. Hennepin Street, Minneapolis, Minnesota 55413

Modern Packaging. McGraw-Hill, Incorporated, 330 W. 42d Street, New York, New York 10036

New England Printer & Lithographer. Sheraton Building, 470 Atlantic Avenue, Boston, Massachusetts 02210

News and Views. International Printing Pressman and Assistants' Union of North America, 1730 Rhode Island Avenue N.W., Washington, D.C. 20036

Newspaper Production. Inter/Com, Incorporated, 19 Church Street, Berea, Ohio 44017

Office Products News. United Technical Publications, 645 Stewart Avenue, Garden City, Long Island, New York 11530

Pamarco Flexographic Newsletter. Pamarco, Incorporated, Roselle, New Jersey 07203

Paper Sales. Ojibway Press, Ojibway Building, Duluth, Minnesota 55802

Penrose Annual. Hastings House, 10 E. 40th Street, New York, New York 10016

Petersen's Photographic Magazine. 6725 Sunset Boulevard, P.O. Box 3414, Los Angeles, California 90028

Photomethods. Gellert Publishing Company, 33 W. 60th Street, New York, New York 10023

Photographic Applications in Science, Technology and Medicine. 41 E. 28th Street, New York, New York 10016

Photographic Science & Engineering. SPSE, Suite 204, 1330 Massachusetts Avenue N.W., Washington, D.C. 20005

Photoplatemakers Bulletin. American Photoplatemakers Association, Suite A1315, 166 Van Buren Street, Chicago, Illinois 60604

PIA Communicator. Printing Industries of America, 1730 N. Lynn Street, Arlington, Virginia 22209

PIA President's Newsletter. Same address.

PIRA News. PIRA, Randalls Road, Leatherhead, Surrey, England

Poligrafico Italiano, Il. 20133 Milano, Via Devoto 5, Italy

Polygraph, Der. Polygraph Verlag GmbH, 6 Frankfurt-am-Main 70, Schaumainkai 85, West Germany

Print (America's Graphic Design Magazine). RC Publications, 527 Madison Avenue, New York, New York 10022

Print-Equip News. 135 S. Maryland Avenue, Glendale, California 91205

Printindia. Amurtha Publications, 111-C Arcot Road, Dokambakkam, Madras 24, S. India

Printers News. Official Journal of New Zealand Printing Industry, Box 26-009, Epsom, Auckland, New Zealand

Printing Abstracts. PIRA, Randalls Road, Leatherhead, Surrey, England

Printing and Publishing. U.S. Department of Commerce, Business and Defense Services Administration, Superintendent of Documents, Government Printing office, Washington, D.C. 20402

Printing Impressions. North American Publishing Company, 134 N. 13th Street, Philadelphia, Pennsylvania 19107

Printing Management with Printing Magazine. Inter/Com, Incorporated, 19 Church Street, Berea, Ohio 44107

Printing News. 468 Park Avenue South, New York, New York 10016

Printing Plates Magazine. 758 Leader Building, Cleveland, Ohio 44114

Printing Salesman's Herald. Champion Papers, Division of Champion International, 245 Park Avenue, New York, New York 10017

Printing Trades Journal. Benn Brothers, Ltd., Bouverie House, Fleet Street, London EC4,

England

Printing Views. Midwest Publishing Company, 8328 N. Lincoln Avenue, Skokie, Illinois 60076

Printing World. Stonhill & Gillis, Ltd., 296-302 High Holborn, London WC 1, England

Professional Printer. Institute of Printing, 10-11 Bedford Row, London WC 1, England

Prophoto. Photoindustrie Verband, 6 Frankfurt-am-Main 1, West Germany

Publishers' Auxiliary. National Newspaper Association, 491 National Press Building, Washington, D.C. 20004

Publishers' Weekly. R. R. Bowker, 1180 Avenue of the Americas, New York, New York 10036

Recherche Graphique, La. IPREIG, 17 Rue des Reculettes, Paris 13, France

Reproduction Bulletin. Andrews Paper & Chemical Company, P.O. Box 509, Port Washington, New York 11050

Reproductions Review and Methods. North American Publishing Company, 134 N. 13th Street, Philadelphia, Pennsylvania 19107

Roland News. Roland Offsetmaschinenfabrik, Faber & Streicher AG, Offenbach-am-Main, West Germany

Scan. Institute of Paper Chemistry, Box 1048, Appleton, Wisconsin 54911

Screen Printing Magazine. Signs of the Times Publishing Company, 407 Gilbert Avenue, Cincinnati, Ohio 45202

Seybold Report. Seybold Publications, Incorporated, Box 193, Moylan, Pennsylvania 19065

Share Your Knowledge Review. International Association of Printing House Craftsmen, 7599 Kenwood Road, Cincinnati, Ohio 45236

SLADE Journal. Society of Lithographic Artists, Designers, Engravers & Process Workers of Great Britain, 54 Doughty Street, London WC 1, England

Southern Printer & Lithographer. Ernest H. Abernethy Publications, 75 Third Street, Atlanta, Georgia 30308

Souther Pulp & Paper Manufacturer. Same address.

TAGA Proceedings. Technical Association of the Graphic Arts, P.O. Box 3064, Federal Station, Rochester, New York 14614

Tech-Topics. Pako, Minneapolis, Minnesota 55440

Typographical Journal. ITU, 301 S. Union Boulevard, Colorado Springs, Colorado 80901

UGRA Mitteilungen. UGRA, Postfach 121, 8030 Zurich, Switzerland

Ulano Bulletin. 210 E. 88th Street, New York, New York 10028

Visible Language. c/o Editor, Cleveland Museum of Art, Cleveland, Ohio 44106

Web Printer's Handbook. Boise Cascade Papers, Advertising Services Department, 1718 S.W. 4th Avenue, Portland, Oregon 97201

What's New(s) in Graphic Arts. International Paper Company, P.O. Box 797, Tuxedo, New York 10987

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